

FORM PTO-1390 (Modified)  
(REV 11-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

## TRANSMITTAL LETTER TO THE UNITED STATES

212810US2PCT

DESIGNATED/ELECTED OFFICE (DO/EO/US)

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

CONCERNING A FILING UNDER 35 U.S.C. 371

09/926078

INTERNATIONAL APPLICATION NO.

INTERNATIONAL FILING DATE

PRIORITY DATE CLAIMED

PCT/JP00/09128

22 December 2000

27 December 1999

TITLE OF INVENTION

RADIO COMMUNICATION APPARATUS AND RADIO COMMUNICATION METHOD

APPLICANT(S) FOR DO/EO/US

UGA Shinsuke et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
  - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
  - b. ☒ has been communicated by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
  - a. ☒ is attached hereto.
  - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
  - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ have been communicated by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

## Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Notice for Consideration of Documents Cited in International Search Report

Notice of Priority

Drawings (24 sheets)

09/926078-082701



09/926078  
JCS Rec'd PCT/TO 27 AUG 2001

212810US-7459-57-2-PCT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF: :  
SHINSUKE UGA ET AL : ATTN: APPLICATION DIVISION  
SERIAL NO: NEW APPLICATION :  
(Based on PCT NO:JP00/09128)  
FILED: HEREWITH : EXAMINER:  
FOR: RADIO COMMUNICATION :  
APPARATUS AND RADIO  
COMMUNICATION METHOD

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS  
WASHINGTON, D.C. 20231

SIR:

Prior to a first examination on the merits, please amend the above-identified  
application as follows:

IN THE SPECIFICATION

Page 22, lines 14-19, please delete the paragraph and replace it with the following  
paragraph:

This method is a variation of OFB (output feedback) mode, which is one of the modes  
utilizing the block cipher defined by ISO/IEC10116. In OFB mode, even if bit errors occur  
due to the noise generated on the transmission paths, the decode processing can prevent the  
bit errors from increasing. For this reason, this mode is often adopted for radio voice  
communication.

Page 22, line 20 to page 23, line 1, please delete the paragraph and replace it with the following paragraph:

The second technique for keeping the security of data is data integrity technique, which detects tampering in the signal information by appending a message authentication code (message authentication code) to the signal information on the radio communication line. This is also called message authentication technique. To implement this data integrity technique, a function for data integrity (hereinafter, referred to as f9) is used. The same encryption algorithm as f8 is employed in the core part of f9.

Page 29, lines 15-20, please delete the paragraph and replace it with the following paragraph:

As data kinds such as speech data are circuit-switched data which remains transparent in the RLC sub-layers, by implementing ARIB defined MT (Mobile Terminal) - TA (Terminal Adaptor) I/F (Figs. 22, 23) as the serial interface for this transport model, it becomes possible to perform confidentiality processing on the MA-TA I/F serial formats without any conversion.

#### IN THE CLAIMS

Please amend Claim 23 as follows:

23. (Amended) The radio communication apparatus of claim 19, wherein the radio communication apparatus is a portable mobile phone.

IN THE ABSTRACT

Page 47, beginning at line 2, please delete the paragraph and replace it with the following paragraph:

A mobile station (MS) which can perform confidentiality processing and integrity processing on a data layer. A confidentiality/integrity processing unit is provided among a terminal IF unit, a radio communication control unit, and a radio communication unit. The confidentiality/integrity processing unit performs only the confidentiality processing on transparent data such as speech data transferred between the terminal IF unit and the radio communication unit. The confidentiality/integrity processing unit performs the confidentiality processing and/or the integrity processing on non-transparent data transferred to/from the radio communication control unit. The confidentiality/integrity unit selectively performs the confidentiality processing or the integrity processing on the data of layer output from the radio communication unit based on the data kind.

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

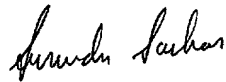
The present preliminary amendment is submitted to correct for minor informalities in the above-identified application. Specifically, by the present preliminary amendment the specification has been amended to correct for minor informalities, Claim 23 has been amended to clarify the terminology, and the Abstract has been amended to be in more proper format under United States practice. Each of the changes made in the present preliminary

- amendment are deemed to be self-evident from the originally filed disclosure, and thus are not deemed to raise any issues of new matter.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,  
MAIER & NEUSTADT, P.C.



Gregory J. Maier  
Attorney of Record  
Registration No. 25,599  
Surinder Sachar  
Registration No. 34,423



**22850**

(703) 413-3000  
Fax No.: (703)413-2220  
SNS/rac  
I:\atty\SNS\212810US-PR.wpd

**Marked-Up Copy**

Serial No: \_\_\_\_\_

Amendment Filed on: \_\_\_\_\_

*08/27/01*

IN THE SPECIFICATION

Page 22, lines 14-19, please delete the paragraph and replace it with the following paragraph:

--This method is a variation of OFB (output feedback) mode, which is one of the modes utilizing the block cipher defined by ISO/IEC10116. In OFB mode, even if bit errors occur due to the noise generated on the transmission paths [is mixed in the ciphertext data], the decode processing can prevent the [noise part] bit errors from increasing. For this reason, this mode is often adopted for radio voice communication.--

Page 22, line 20 to page 23, line 1, please delete the paragraph and replace it with the following paragraph:

--The second technique for keeping the security of data is data integrity technique, which detects tampering in the signal information by appending a message authentication code (message authentication code) to the signal information on the radio communication line. This is also called message authentication technique. To implement this data integrity technique, a function for data integrity (hereinafter, referred to as f9) is used. The same encryption algorithm as [F8] f8 is employed in the core part of f9.--

Page 29, lines 15-20, please delete the paragraph and replace it with the following paragraph:

--As data kinds such as speech data are [used] circuit-switched data which remains transparent in the RLC sub-layers, by implementing ARIB defined MT (Mobile Terminal) - TA ([Terminal] Terminal Adaptor) I/F (Figs. 22, 23) as the serial interface for this transport model, it becomes possible to perform confidentiality processing on the MA-TA I/F serial formats without any conversion.--

#### IN THE CLAIMS

Please amend Claim 23 as follows:

--23. (Amended) The radio communication apparatus of claim 19, wherein the radio communication apparatus is a portable mobile phone.--

#### IN THE ABSTRACT

Page 47, beginning at line 2, please delete the paragraph and replace it with the following paragraph:

--[The present invention aims to provide a] A mobile station (MS) [100] which can perform confidentiality processing and integrity processing on a data layer [2 or upper]. A confidentiality/integrity processing unit [40] is provided among a terminal IF unit [10], a radio communication control unit [20], and a radio communication unit [30]. The confidentiality/integrity processing unit [40] performs only the confidentiality processing on transparent data such as speech data transferred between the terminal IF unit [10] and the radio communication unit [30]. The confidentiality/integrity processing unit [40] performs the confidentiality processing [or/and] and/or the integrity processing on non-transparent data transferred to/from the radio communication control unit [20]. The confidentiality/integrity



unit [40] selectively performs the confidentiality processing or the integrity processing on the data of layer [2 or upper] output from the radio communication unit [30] based on the data kind.--

24/1/85

1

09/926078

JCO3 Rec'd PCT/JP00 27 AUG 2001

ENGLISH TRANSLATION FOR PCT/JP00/09128

SPECIFICATION

Radio Communication Apparatus and Radio Communication Method

5 Technical Field

This invention relates to a radio communication apparatus and a radio communication method for devices such as a cellular phone. In particular, the invention relates to a cellular phone which performs data confidentiality and integrity processing.

10

Background Art

Fig. 24 shows a conventional cellular phone 500.

A terminal IF (interface) unit 510, a radio communication control unit 520 and a radio communication unit 530 are provided to the conventional cellular phone 500. The terminal IF unit 510 performs interface with a user of the cellular phone 500. The radio communication control unit 520 performs communication control of the whole cellular phone, data conversion and data processing based on protocol. The radio communication unit 530 modulates and demodulates data to enable radio communication. The radio communication unit 530 supports the physical layer (layer 1), which is the lowermost layer of seven layers defined by OSI (Open Systems Interconnection). A confidentiality processing unit 540 is provided to the radio communication unit 530. The confidentiality processing unit 540 encrypts or decrypts data of the physical layer to be processed by the radio communication unit 530. As the data sent/received

0926078-08204

by an antenna 541 is encrypted by providing the confidentiality processing unit 540, wiretappers are prevented from obtaining any significant information unless the encryption codes are broken.

The conventional cellular phone 500 has the confidentiality processing unit 540 within the radio communication unit 530. Accordingly, the data to be processed by the confidentiality processing unit 540 is stored in the physical layer (layer 1). At the physical layer, it is impossible to discriminate data between user data and control data. Data sent/received by the cellular phone includes various kinds of data such as user data or signaling data, and it is required to perform data confidentiality processing based on the data kinds, or to ensure data integrity depending on the significance of the data. As shown in the conventional architecture, since the confidentiality processing unit 540 is provided to the layer 1, the data cannot be performed the confidentiality processing nor the integrity processing based on the data kind because it is impossible to discriminate the data kinds at the layer 1.

A preferred embodiment of the present invention aims to obtain a radio communication apparatus and a radio communication method performing confidentiality processing and the integrity processing of data based on the data kind.

Further, another objective of the preferred embodiment of the present invention is to obtain the radio communication apparatus and the radio communication method performing the data confidentiality processing and the data integrity processing at a higher layer equal to or greater than layer 2 (data link layer) of the seven layer of the OSI.

Further, another objective of the preferred embodiment of the present invention is to obtain the radio communication apparatus and the radio communication method selectively performing both of or either of the confidentiality processing of data and the integrity processing based on the data kind.

Further, another objective of the preferred embodiment of the present invention is to obtain the radio communication apparatus and the radio communication method performing data confidentiality/integrity processing for each channel in case the radio communication apparatus has multiple channels.

Further, another objective of the preferred embodiment of the present invention is to obtain the radio communication apparatus and the radio communication method which selectively performs either confidentiality or integrity processing on the data by discriminating between transparent and non-transparent data through a certain layer or a sub-layer.

#### Disclosure of the Invention

A radio communication apparatus according to the invention includes:

a terminal interface unit for inputting data;

a radio communication control unit for inputting the data input by the terminal interface unit, for processing the data based on protocol, and outputting the data;

a confidentiality/integrity processing unit for inputting a control signal and data from the radio communication control unit, performing at

least one of encryption of the data as confidentiality processing and generation of a message authentication code for detecting tampered data as integrity processing on the data input, and outputting the data processed to the radio communication control unit; and

5           a radio communication unit for inputting, modulating, and sending the data output from the radio communication control unit.

The confidentiality/integrity processing unit inputs the control signal from the radio communication control unit and selectively inputs the data from the terminal interface unit based on the control signal input, and

10           the confidentiality/integrity processing unit performs confidentiality processing on the data input and outputs the data which has been performed confidentiality processing to the radio communication unit.

The terminal interface unit outputs transparent data and non-transparent data, and

15           the radio communication control unit inputs the non-transparent data from the terminal interface unit, makes the confidentiality/integrity processing unit process the non-transparent data based on protocol, and

the radio communication control unit controls the transparent data to be transferred from the terminal interface unit to the  
20   confidentiality/integrity processing unit to perform the confidentiality processing.

The confidentiality/integrity processing unit is connected to the radio communication control unit via parallel interface.

The confidentiality/integrity processing unit is connected to the  
25   terminal interface unit with serial interface and connected to the radio

09926078-082701

communication unit with serial interface.

The confidentiality/integrity processing unit further includes:

a confidentiality processing unit including an encrypting unit for encrypting the data input; and

5 an integrity processing unit having a message authentication code appending unit for appending a message authentication code to the data input.

The confidentiality/integrity processing unit includes multiple encrypting units.

10 The confidentiality/integrity processing unit includes multiple message authentication code appending units.

The confidentiality processing unit and the integrity processing unit form one module which inputs the control signal and the data from the radio communication control unit, and the module performs at least one of the  
15 confidentiality processing and the integrity processing on the data input based on the control signal input.

A radio communication apparatus according to the invention includes:

a radio communication unit for receiving and demodulating data;

20 a radio communication control unit for inputting data demodulated by the radio communication unit, processing the data based on protocol, and outputting the data processed;

a confidentiality/integrity processing unit for inputting a control signal and the data from the radio communication control unit, based on the  
25 control signal input performing at least one of confidentiality processing of

decrypting the data and integrity processing of detecting tampered data, and outputting the data processed to the radio communication control unit; and

a terminal interface unit for inputting the data processed from the radio communication control unit and outputting the data.

5       The confidentiality/integrity processing unit inputs the control signal from the radio communication control unit and selectively inputs the data from the radio communication unit based on the control signal input, and

the confidentiality/integrity processing unit performs the confidentiality processing on the data input and outputs the data processed  
10 to the terminal interface unit.

The radio communication unit outputs transparent data and non-transparent data,

the radio communication control unit inputs the non-transparent data from the radio communication unit and makes the  
15 confidentiality/integrity processing unit process the non-transparent data based on protocol, and

the radio communication control unit controls the transparent data to be transferred from the radio communication unit to the confidentiality/integrity processing unit to perform the confidentiality  
20 processing.

The confidentiality/integrity processing unit is connected to the radio communication control unit with a parallel interface.

The confidentiality/integrity processing unit is connected to the terminal interface unit with a serial interface, and connected to the radio  
25 communication unit with a serial interface.

09925078-083701  
T04280-82092260

The confidentiality/integrity processing unit includes:

a confidentiality processing unit having a decrypting unit for decrypting the data input; and

an integrity processing unit having an integrity verification unit for  
5 verifying an integrity of the data input using a message authentication code  
appended to the data input.

The confidentiality processing unit includes multiple decrypting  
units.

The integrity processing unit includes multiple integrity verification  
10 units.

The confidentiality processing unit and the integrity processing unit  
form one module which inputs the control signal and the data from the radio  
communication control unit, and wherein the module, based on the control  
signal input, performs at least one of processes of the confidentiality  
15 processing unit and the integrity processing unit on the data input.

A radio communication apparatus for wireless data communication  
according to the invention includes:

a terminal interface unit for data input/output;

a radio communication control unit for processing the data based on  
20 protocol;

a radio communication unit for wireless data communication;

a confidentiality/integrity processing unit, provided among the  
terminal interface unit, the radio communication control unit, and the radio  
communication unit, which performs at least one of confidentiality  
25 processing for encrypting/decrypting data and integrity processing for

09926078-082701



detecting tampered data on the data input/output from/to the radio communication control unit, encrypts the data from the terminal interface unit to the radio communication unit, and decrypts the data from the radio communication unit to the terminal interface unit.

5           The confidentiality/integrity processing unit includes a confidentiality processing unit for performing a confidentiality processing on the data input, and an integrity processing unit for performing an integrity processing on the data input, separately.

10           The confidentiality processing unit separately includes an encrypting unit for encrypting the data from the terminal interface unit to the radio communication unit, and a decrypting unit for decrypting the data from the radio communication unit to the terminal interface unit.

15           The integrity processing unit separately includes a message authentication code appending unit for appending a message authentication code to the data input for performing an integrity verifying process, and an integrity verification unit for verifying an integrity of the data input using the message authentication code appended to the data input.

          The communication apparatus is a portable mobile phone.

20           The confidentiality processing unit and the integrity processing unit employ same encryption algorithm.

          The confidentiality processing unit and the integrity processing unit employ same encryption algorithm.

          The confidentiality processing unit and the integrity processing unit employ same encryption algorithm.

25           The communication apparatus is a cellular phone.

The radio communication apparatus is a cellular phone.

The communication apparatus is a cellular phone.

The radio communication apparatus is a radio station for sending/receiving data to/from a mobile station.

5       The radio communication apparatus is a radio station for sending/receiving data to/from a mobile station.

The radio communication apparatus is a radio station for sending/receiving data to/from a mobile station.

10       The radio station is either of a base transceiver station and a radio network controller.

The radio station is either of a base transceiver station and a radio network controller.

The radio station is either of a base transceiver station and a radio network controller.

15       A radio communication method according to the invention includes:

a terminal interface step for inputting data;

a radio communication control step for inputting the data input by the terminal interface step and for processing the data based on protocol and outputting the data;

20       a confidentiality/integrity processing step for inputting a control signal and data from the radio communication step, performing at least one of encryption of the data as confidentiality processing and generation of a message authentication code for detecting tampered data as integrity processing on the data input, and outputting the data processed to the radio  
25       communication control step; and

09926078-082701  
F02280-8209260

a radio communication step for inputting, modulating, and sending the data output from the radio communication control step.

A radio communication method according to the invention includes:

a radio communication step for receiving and demodulating data;

5 a radio communication control step for inputting data demodulated by the radio communication step, processing the data based on protocol, and outputting the data processed;

a confidentiality/integrity processing step for inputting a control signal and the data from the radio communication control step, based on the control signal input performing at least one of confidentiality processing of decrypting the data and integrity processing of detecting tampered data, and outputting the data processed to the radio communication control step; and

a terminal interface step for inputting the data processed from the radio communication control step and outputting the data.

15 A radio communication method for wireless data communication according to the invention includes:

a terminal interface step for data input/output;

a radio communication control step for data processing based on protocol;

20 a radio communication step for wireless data communication; and

a confidentiality/integrity processing step, provided among the terminal interface step, the radio communication control step, and the radio communication step, and which performs at least one of confidentiality processing for encrypting/decrypting data and integrity processing for detecting tampered data on the data input/output from/to the radio

communication control step, encrypts the data transferred from the terminal interface step to the radio communication step, and decrypts the data transferred from the radio communication step to the terminal interface step.

5

#### Brief Explanation of the Drawings

Fig. 1 shows a configuration of a mobile communication system.

Fig. 2 shows a configuration of a radio network controller (RNC) 120.

Fig. 3 shows a configuration of a mobile station (MS) 100 according to  
10 the first embodiment.

Fig. 4 shows a configuration of a confidentiality/integrity processing unit 40 according to the first embodiment.

Fig. 5 shows a configuration of a confidentiality/integrity processing unit 40 according to the first embodiment.

15 Fig. 6 shows a configuration of a confidentiality/integrity processing unit 40 according to the first embodiment.

Fig. 7 shows a configuration of a confidentiality/integrity processing unit 40 according to the first embodiment.

20 Fig. 8 shows a configuration of a confidentiality/integrity processing unit 40 according to the first embodiment.

Fig. 9 shows a configuration of a mobile station (MS) 100 according to the second embodiment.

Fig. 10 shows a configuration of a confidentiality/integrity processing unit 40 according to the second embodiment.

25 Fig. 11 shows a configuration of a confidentiality/integrity processing

T02280-82092660

unit 40 according to the second embodiment.

Fig. 12 shows an example of encrypting/decrypting systems.

Fig. 13 shows a configuration of a confidentiality/integrity processing unit 40 according to the second embodiment.

5 Fig. 14 is an illustration shown in ARIB STD-T63 33.102,3G Security; Security Architecture, Section 6.3.

Fig. 15 is an illustration shown in ARIB STD-T63 33.102,3G Security; Security Architecture, Figure 16b.

10 Fig. 16 is an illustration shown in ARIB STD-T63 33.102,3G Security; Security Architecture, Figure 16.

Fig. 17 shows a configuration of an encrypting module 51 (or a decrypting module 71) employed within a encrypting/decrypting 421.

Fig. 18 shows an installing form of the confidentiality/integrity processing unit 40.

15 Fig. 19 shows a case in which the confidentiality/integrity processing unit 40 is implemented by software.

Fig. 20 shows a mechanism for calling cipher program 47 by an application program executed in a radio communication control unit 20.

20 Fig. 21 shows a concrete example of data 92, 93 in case of RLC non-transparent mode.

Fig. 22 shows a concrete example of voice data as one example of transparent data 95, 96.

Fig. 23 shows a concrete example of unrestricted digital data as one example of transparent data 95, 96.

25 Fig. 24 shows a conventional cellular phone 500.

09926078-083701  
T02280-82092660

## Preferred Embodiment of Carrying Out the Invention

### Embodiment 1.

Fig. 1 shows a general configuration of a mobile communication  
5 system according to this embodiment.

A mobile station (MS) is one example of the radio communication  
apparatus according to the invention. The mobile station (MS) 100 is, for  
example, a cellular phone. The mobile station (MS) 100 is connected to a  
base transceiver station (BTS) 110 by radio. The base transceiver station  
10 (BTS) 110 is connected to a radio network controller (RNC) 120. The radio  
network controller (RNC) 120 is connected to another radio network  
controller (RNC) 120. The radio network controller (RNC) 120 is also  
connected to a core network (CN) 130, and further connected to another radio  
network controller (RNC) 120 via the core network (CN) 130. One or both of  
15 the base transceiver station (BTS) 110 and the radio network controller  
(RNC) 120 can be referred to as a radio station.

Fig. 2 shows a configuration of the same mobile communication  
system as shown in Fig. 1. In particular, the figure shows the internal  
configuration of the radio network controller (RNC) 120.

20 A BTS IF unit 121 connects the base transceiver station (BTS) 110.  
A handover control unit 122 controls handover in case the mobile station  
(MS) 100 moves between the base transceiver stations (BTS) 110.

A signal control unit 123 for MS performs radio communication  
control and data confidentiality/integrity processing while communicating  
25 with the mobile station (MS) 100. The following confidentiality/integrity

processing of the mobile station (MS) 100 is performed corresponding to the confidentiality/integrity processing of the signal control unit 123 for MS. Namely, data encrypted by the mobile station (MS) 100 is decrypted by the signal control unit 123 for MS. In reverse, the data encrypted in the signal control unit 123 for MS is decrypted in the mobile station (MS) 100. An authentication code appended by the mobile station (MS) 100 to ensure the integrity of data is checked by the signal control unit 123 for MS. In reverse, the authentication code appended by the signal control unit 123 for MS to ensure the integrity of data is checked by the mobile station (MS) 100. The data confidentiality processing or the data integrity processing is performed at the second layer of the seven layers, that is, layer 2 (data link layer). A CN IF unit 124 interfaces with the core network (CN) 130.

A RNC IF unit 125 interfaces with another radio network controller (RNC) 120. A signal control unit 126 for CN performs control with a core network (CN) 130. A signal control unit 127 for RNC performs control with another radio network controller (RNC) 120. A control unit 128 controls the whole radio network controller (RNC) 120. A switch 129 switches control signals and packet data based on the control performance of the control unit 128 among the radio station (BTS) 110, the radio network controller (RNC) 120 and the core network (CN) 130. Namely, the switch 129 switches not only the packet data, but all data kinds such as speech data, and further the switch 129 also switches the control signals.

Fig. 3 shows a configuration of the mobile station (MS) 100.

The mobile station (MS) 100 includes a terminal IF unit 10, a radio communication control unit 20, a radio communication unit 30 and a

confidentiality/integrity processing unit 40. A camera 1, a video 2, B/T (Blue Tooth) 3, an LCD 4, a KEY 5, an LED 6, a USIM (Universal Subscriber Identity Module) 7, a RECEIVER 8, a MIC 9, and an HSJ (Head Set Jack) 0 are connected to the terminal IF unit 10. These devices of the camera 1  
5 through the HSJ 0 perform interface processing with a user (a person) or a device to be connected, and the devices input or output information which can be recognized by the user (person) or the device to be connected.

The terminal IF unit 10 includes a module IF unit 11 for each module, a data format converter 12, a terminal IF control unit 13, and a speech  
10 encoding/decoding unit 14. The module IF unit 11 for each module interfaces with each of the devices of the camera 1 through the HSJ 0. The data format converter 12 converts the data formats processed by the devices of the camera 1 through the HSJ 0 to/from the data formats processed inside the mobile station (MS) 100. The terminal IF control unit 13 controls the  
15 operation of the terminal IF unit 10. The speech encoding/decoding unit 14 encodes speech electric signals input by the MIC 9 into speech code. Further, the speech encoding/decoding unit 14 decodes the encoded signals to output the speech electric signals to the RECEIVER 8.

The radio communication control unit 20 controls the whole mobile  
20 station (MS) 100. The radio communication control unit 20 is provided with a hardware circuit including a CPU, a ROM, a RAM, a firmware, and the like, or software module. The radio communication control unit 20 processes data between the terminal IF unit 10 and the radio communication unit 30. The radio communication control unit 20 converts data based on rules  
25 defined by the standard or the protocol. In particular, the radio



communication control unit 20 processes data of layer 2 or upper levels of layer, by such functions as packeting or concatenating the data. The radio communication control unit 20 can discriminate the data kind, because the radio communication control unit 20 processes the data of layer 2 or upper.

5 Accordingly, the radio communication control unit 20 can judge if certain data should undergo the confidentiality processing or the integrity processing based on the data kind. It is impossible to discriminate the data kind at the layer 1, and therefore it is impossible to judge whether the data should be performed the confidentiality processing or the integrity  
10 processing.

The radio communication unit 30 is provided with a channel encoding unit 310, a baseband modulating/demodulating unit 320, a radio unit 330, and an antenna 34. The channel encoding unit 310 includes encoding units and decoding units for respective channels. The encoding  
15 unit includes an error detection encoding unit 311, an error correction encoding unit 312, and a physical format converter 313. Further, the decoding unit includes a physical format converter 314, an error correction decoding unit 315, and an error detection unit 316. The baseband modulating/demodulating (MODEM) unit 320 modulates and demodulates  
20 the band. The baseband modulating/demodulating unit 320 includes a baseband modulator 321 and a baseband demodulator 322. The radio unit 330 converts the baseband signals into transmission spectrum, or reverse the conversion. The radio unit 330 includes an up-converter 331 and a down-converter 332.

25 The confidentiality/integrity processing unit 40 is connected to the

radio communication unit 20. The confidentiality/integrity processing unit 40 receives data from the radio communication control unit 20 and performs the data confidentiality processing. Further, the confidentiality/integrity processing unit 40 ensures the integrity of the data. The confidentiality/integrity processing unit 40 inputs a control signal 91 from the radio communication control unit 20 for the data confidentiality/integrity processing. Further, the confidentiality/integrity processing unit 40 inputs data 92 of an arbitrary layer of 2 or upper levels of layer as the processing data of the confidentiality processing and/or data 92 of an arbitrary layer of 2 or upper levels of layer as the processing data of the integrity processing from the radio communication control unit 20. The confidentiality/integrity processing unit 40 performs the confidentiality processing and/or the integrity processing of the data 92 based on the input control signal 91 to output to the radio communication control unit 20. The control signal 91 includes parameters such as a key, an initial value, selection between the confidentiality processing and the integrity processing.

Fig. 4 shows a configuration of the confidentiality/integrity processing unit 40.

The confidentiality/integrity processing unit 40 includes an IF unit 410 and a module 411. The module 411 performs the confidentiality processing and the integrity processing within the same circuit or using the same algorithm. The selection between the confidentiality processing and the integrity processing is determined by the control signal 91.

Here, the confidentiality processing means encrypting or decrypting the data. Further, the integrity processing means detecting data tampering

by appending authentication codes to the data or reproducing and comparing the authentication codes.

The confidentiality processing and the integrity processing can be performed by the same circuit or algorithm, or by a similar circuit or a similar module. Accordingly, as shown in Fig. 4, the confidentiality processing and the integrity processing can be performed by a single module 411. In case of Fig. 4, it is possible to reduce the hardware resource and the software resource. Hereinafter, a “module” refers to the ones implemented either by hardware or software only, or by combining the both tools.

Here, concrete examples of the confidentiality processing and the integrity processing used for the cellular phone will be explained.

Fig. 14 is a figure shown in ARIB STD-T63 33.102,3G Security; Security Architecture, Section 6.3.

Fig. 15 is a figure shown in ARIB STD-T63 33.102,3G Security; Security Architecture, Figure 16b.

Fig. 16 is a figure shown in ARIB STD-T63 33.102,3G Security; Security Architecture, Figure 16.

Fig. 14 shows an encrypting method on the radio line. Signs shown in Fig. 14 mean the following:

CK: cipher key (encryption key)

F8: function for data confidentiality processing

IK: integrity key (message authentication key)

F9: function for data integrity processing

Cellular phone carriers implement authentication using functions f1 through f5. The 128-bit encryption keys called CK and IK generated

through this authentication process are transferred to the function for data confidentiality processing (f8) and the function for data integrity processing (f9).

Fig. 15 shows an encrypting method on the radio line. The signs  
5 shown in Fig. 15 mean the following:

f8: function for data confidentiality processing

CK: cipher key (encryption key)

MESSAGE: plaintext data which a sender wants to send to a receiver  
such as user data and signal information before encryption

10 COUNT-C: numeral value data showing the accumulated number of  
transmission/reception, incremented by 1 at each session.

BEARER: bit for identifying logical channel

DIRECTION: bit for discriminating the direction of transmission of  
ciphertext

15 LENGTH: bit length of MESSAGE or ciphertext data

As shown in Fig. 15, encryption/decryption of the data is performed  
based on a random number sequence generated by the function f8 for data  
confidentiality processing.

Fig. 16 shows a method for generating message authentication code.

20 Signs shown in Fig. 16 mean the following:

f9: function for data integrity processing

IK: integrity key (message authenticating key)

COUNT-I: numeral value data showing the accumulated number of  
transmission/reception, incremented by 1 at each session

25 MESSAGE: plaintext data which a sender wants to send to a receiver

such as user data and signal information before encryption

DIRECTION: bit for discriminating the direction of transmission

FRESH: random number generated for each user

MAC-I: message authentication code for integrity (message  
5 authentication code computed by the sender)

XMAC-I: expected message authentication code for integrity  
(message authentication code computed by the receiver)

As shown in Fig. 16, the integrity of the data can be checked by  
comparing two message authentication codes at the receiver side.

10 In the following, the operation will be explained.

To perform ciphered communication between the terminal and the  
network within the radio network, authentication process is required, in  
which one partner confirms the other is a proper partner, or both partners  
mutually confirm the other is proper before sending/receiving data between  
15 the two partners.

As shown in Fig. 14, during a series of authentication processes, both  
the terminal and the network use five functions named functions f1 through  
f5. In parallel with the authentication process, the function generates a  
cipher key (CK) of 128 bits and a message authentication key (integrity key,  
20 IK) at both the terminal and the network.

The two keys can be shared exclusively by the terminal and the  
network which have been mutually authenticated, and the two keys are used  
within the two functions f8 and f9 described below. The two keys vary for  
each communication session, and further, there are no patterns among keys  
25 generated. Then, the keys are discarded when the communication is over.

The mechanism (protocol) required for this authentication process is standardized. However, as the functions of f1 to f5 are not standardized, operators decide these functions independently.

The data security after authentication processing is maintained by  
5 the data confidentiality and integrity processing techniques.

The first, data confidentiality technique is applied to encrypt the user data and the signal information including speech transferred on the radio network, and for preventing wiretapping. To implement this data confidentiality processing, a function called data confidentiality function  
10 (hereinafter, referred to as f8) is employed.

In the case of communicating data which has undergone confidentiality processing as shown in Fig. 15, the sender uses the encryption key (CK) generated at authentication process. Further, a random number sequence is generated by inputting a bit length (LENGTH)  
15 of the target data for encryption/decryption, an up/down link (DIRECTION), a counter (COUNT-C), a logic channel identifier (BEARER) to f8.

Here, the up/down link means those distinguishing bits which indicates the transmission direction of ciphertext data between a terminal and a base station. Further, the counter is data showing the number of  
20 accumulated times of sending/receiving data. At each sending/receiving the data, a fixed value is added to the counter. The counter is used for preventing an attack which tries to send the ciphertext data that has been sent previously. Yet further, the logic channel identifier means a bit for identifying a logical channel performing encryption.

25 Ciphertext data is generated by XORing the random number

sequence generated above and the data/signal information to be encrypted and sent to the receiver.

The parameters except CK are sent from the sender to the receiver without encryption. It is unnecessary to send CK because the same  
5 parameter is generated at the receiver side at authentication process.

Even if the parameters other than CK are obtained by the third party, the security of the original message can be kept, as the random number sequence required to decrypt the ciphertext data cannot be generated as long as CK remains secret.

10 At the receiver side, the random number sequence is generated using the received parameters and CK which has been already obtained, the random number sequence is XORed with the ciphertext data received to decrypt into the original message.

This method is a variation of OFB (output feedback) mode, which is  
15 one of the modes utilizing the block cipher defined by ISO/IEC10116. In OFB mode, even if noise generated on the transmission paths is mixed in the ciphertext data, the decode processing can prevent the noise part from increasing. For this reason, this mode is often adopted for radio voice communication.

20 The second technique for keeping the security of data is data integrity technique, which detects tampering in the signal information by appending a message authentication code (message authentication code) to the signal information on the radio communication line. This is also called message authentication technique. To implement this data integrity  
25 technique, a function for data integrity (hereinafter, referred to as f9) is used.

The same encryption algorithm as F8 is employed in the core part of f9.

First, on authentication, the message authentication key (IK) is derived from the function f4 for generating the message authentication key, and the message authentication key is transferred to f9. As shown in Fig.

5 16, a message authentication code (MAC-I or XMAC-I) is generated by inputting the data (MESSAGE), the up/down link (DIRECTION), the counter (COUNT-C), the random number (FRESH) generated for each user as well as the message authentication key.

These parameters are also sent to the receiver by using an area of  
10 data format which is not encrypted by the sender. Even if the parameters are obtained by the third party, the confidentiality of the data can be kept as long as the message authentication key (IK) is kept secret, which is the same as the case of data confidentiality.

The sender sends the data with appending this message  
15 authentication code (MAC-I) appended to the receiver. The receiver, similarly, computes the message authentication code (XMAC-I) by using f9. It can be confirmed there is no tampering by comparing MAC-I and XMAC-I to find them identical.

Here, the following shows some examples of subsequent process in  
20 case of tamper detection:

- (1) Request the retransmission of the data and check if the received message authentication code is proper or not.
- (2) Disconnect the connection in case of consecutive tamper detection.

According to 3GPP specification (for more information, access  
25 [http://www.3gpp.org/About\\_3GPP/3gpp.htm](http://www.3gpp.org/About_3GPP/3gpp.htm)), the encryption/decryption



module has the function to encrypt the input plaintext data (data to be encrypted) into the ciphertext data (encrypted data) and output the ciphertext data, and the function to decrypt the ciphertext data into the plaintext data and output the plaintext data. Assuming the embodiment is  
 5 compliant to the 3GPP specification, the above COUNT/BERARER/DIRECTION/CK/LENGTH correspond to the control signal 91 shown in Fig. 3 as concrete examples.

Further, as for concrete examples of the data 92 and 93 shown in Fig. 3, for example, "MACSDU" or "RLCPDU (datapart)" corresponds as shown in  
 10 Fig. 21. Here, "RLCSDU (datapart)" is a part of RLCPDU, from which the upper 1 Oct or 2 Octs (1 byte or 2 bytes) is deleted (the part of "DATA FOR CIPHERING" shown in Fig. 21). "MACSDU" or "RLCPDU (datapart)" is an example of MESSAGE shown in Fig. 15. Yet further, MACSDU denotes Media Access Control Service Data Unit. RLCPDU denotes Radio Link  
 15 Control Protocol Data Unit. Each message within the message flow is structured from RLCPDU at the layer 3 after deleting RLC header.

Although RLCPDU has 1-Oct or 2-Oct part which is not subjected to confidentiality processing, all of the RLCPDU is input to the confidentiality/integrity processing unit 40 and the unit opt not to perform  
 20 confidentiality/integrity processing on the 1-Oct or 2-Oct part. This is in order to reduce the load of the radio communication control unit 20 wherein the load is generated by shifting 1 Oct or 2 Oct for removing the excluded part of 1 Oct or 2 Oct from the all data unit (RLCPDU).

Fig. 5 shows another example of the confidentiality/integrity  
 25 processing unit 40.

As featured in Fig. 5, a confidentiality processing unit 420 and an integrity processing unit 430 are provided separately. Inside the confidentiality processing unit 420, an encrypting/decrypting unit 421 is provided. Inside the integrity processing unit 430, a message authentication code appending/integrity verification unit 431 is provided. The encrypting/decrypting unit 421 shows a case in which the encryption and the decryption are performed using an identical module. The message authentication code appending/integrity verification unit 431 shows a case in which appending the message authentication code and verifying the integrity are performed using an identical module. A case shown in Fig. 5 is a configuration in which the encryption and the decryption are performed by the same function or appending the message authentication code and verifying the integrity are performed by the same function. Compared with Fig. 6, it is possible to reduce the hardware resource and the software resource within the case of Fig. 5.

Fig. 6 shows another example of the confidentiality/integrity processing unit 40.

As featured in Fig. 6, inside the confidentiality processing unit 420, an encrypting unit 422 and a decrypting unit 423 are provided separately. Further, inside the integrity processing unit 430, a message authentication code appending unit 432 and an integrity verification unit 433 are provided separately. A case shown in Fig. 6 is a configuration in which the encryption and the decryption are performed by different functions or appending the message authentication code and verifying the integrity are performed by different functions. It is possible to respectively perform encrypting,

decrypting, appending the message authentication code, verifying the integrity, and further the data confidentiality processing or the integrity processing can be simultaneously performed in parallel on sent/received data. Accordingly, the high speed processing can be done.

5            Fig. 7 shows a case in which multiple encrypting units 422 and multiple decrypting units 423 are provided in the confidentiality processing unit 420. Further, as shown in the figure, multiple message authentication code appending units 432 and multiple integrity verification units 433 are provided in the integrity processing unit 430. While the mobile station  
10 (MS) 100 is operating, there may be a case in which data in multiple channels should be processed at the same time. For example, when two kinds of data such as speech data and facsimile data are simultaneously transferred, data of at least two channels should be simultaneously processed. In such a case, the speech data can be encrypted by the  
15 encrypting unit 1, and the facsimile data can be encrypted by the encrypting unit 2. Further, in case of decryption, data on multiple channels can be decrypted simultaneously. It is not necessary to have the same number (n in case of Fig. 7) of the encrypting units 422, the decrypting units 423, the message authentication code appending units 432, and the integrity  
20 verification units 433. The number of each units can be determined according to the number of channels to be processed simultaneously by the mobile station (MS) 100. In another way, the above units do not correspond to each channel, but when a certain channel needs to process a large amount of data at a high speed, it is possible to make two encrypting units process  
25 the large amount of data assigned to the channel. Namely, the number of

09926078-082701

each unit such as the encrypting unit 422, the decrypting unit 423, the message authentication code appending unit 432, and the integrity verification unit 433 can be determined according to the number of channels to be processed simultaneously and/or amount of data.

5 Further, the maximum number of the encrypting units 422 and the maximum number of the decrypting units 423 can be different.

Further, the maximum number of the message authentication code appending units 432 and the maximum number of the integrity verification units 433 can be different.

10 Fig. 8 shows the case in which the confidentiality processing unit 420 is provided with multiple encrypting/decrypting units 421. Further, as shown in the figure, the integrity processing unit 430 is provided with multiple message authentication code appending/integrity verification units 431.

15 In Fig. 8, the encrypting/decrypting unit 421 and the message authentication code appending/integrity verification unit 431 shown in Fig. 5 are respectively made multiple. In case of Fig. 8, when the encryption and the decryption are performed using the same function, multiple encrypting/decrypting units 421 are provided corresponding to multiple  
20 channels. Similarly, when the message authentication code appending and the integrity verification are performed using the same function, multiple message authentication code appending/integrity verification units 431 are provided corresponding to multiple channels. Compared with the case shown in Fig. 7, the configuration of Fig. 8 can reduce the hardware resource  
25 and the software resource.

09926078-082704  
T02280" 82092260

In cases shown in Figs. 4 through 8, the confidentiality/integrity processing unit 40 includes both the confidentiality processing unit 420 and the integrity processing unit 430. However, the confidentiality/integrity processing unit 40 can include either of the confidentiality processing unit 420 and the integrity processing unit 430. When the confidentiality/integrity processing unit 40 includes either of the confidentiality processing unit 420 and the integrity processing unit 430, the process of the other can be performed by the radio communication control unit 20.

#### Embodiment 2.

Fig. 9 shows another configuration of the mobile station (MS) 100.

Different from the configuration of Fig. 3, in Fig. 9, data is input/output between the terminal IF unit 10 and the confidentiality/integrity processing unit 40. And further, data is also input/output between the radio communication unit 30 and the confidentiality/integrity processing unit 40. In Fig. 9, non-transparent data 97 is non-transparent data such as packet data. Further, transparent data 95, 96 are transparent data such as speech data, unrestricted digital data. Transparent data means the data is not changed throughout input to output in any layers or sub-layers of the OSI reference layers. Whereas, the non-transparent data means the data requires some data processing such as data format conversion through input to output in some layers or sub-layers of the OSI reference layers. For example, at an RLC (Radio Link Control) sub-layer of the layer 2, when SDU (Service Data Unit) and PDU (Protocol Data Unit) of data are different, the data is non-transparent data. When SDU

and PDU of data at MAC (Media Access Control) sub-layer of the layer 2 are same, the data is transparent data. In case shown in Fig. 9, the transparent data is, for example, speech data which can be transferred to the terminal IF unit 10 without any processing on the data of the layer 1 input/output by the radio communication unit 30. On the other hand, the non-transparent data is, for example, packet data which requires some processing on the data of layer 1 output from the radio communication unit 30.

As mentioned above, the concrete examples of transparent data 95 and 96 in Fig. 9 are speech data and unrestricted digital data, each divided by transport block unit defined between layer 1 and layer 2. These transparent data divided by transports block unit equal to MACPDU (and MACSDU), and therefore each data of the transport block unit corresponds to the confidentiality processing unit.

As data kinds such as speech data are user data which remains transparent in the RLC sub-layers, by implementing ARIB defined MT (Mobile Terminal) – TA (Tarminial Adaptor) I/F (Figs. 22, 23) as the serial interface for this transport model, it becomes possible to perform confidentiality processing on the MA-TA I/F serial formats without any conversion.

Further, a concrete example of the non-transparent data 97 is, as described above, packet data or data for signaling, however, each data is divided into units (Transport Block) defined between the layers 1 and 2.

The confidentiality/integrity processing unit 40 shown in Fig. 9 performs the confidentiality processing and the integrity processing

selectively on the non-transparent data input/output from/to the radio communication control unit 20, and at the same time, the confidentiality/integrity processing unit 40 always performs, for example, the confidentiality processing on the transparent data input/output between the terminal IF unit 10 and the radio communication unit 30. The confidentiality/integrity processing unit 40 does not perform the integrity processing on the transparent data. If the transparent data includes data which does not require the confidentiality processing, the radio communication control unit 20 makes the transparent data which does not require the confidentiality processing not input to the confidentiality/integrity processing unit 40, but input to the radio communication control unit 20. Or it is possible to make the transparent data which does not require the confidentiality processing input to the confidentiality/integrity processing unit 40, but not perform the confidentiality processing on the transparent data using the control signal from the radio communication control unit 20.

Fig. 10 shows a configuration of the confidentiality/integrity processing unit 40.

Different from the configuration shown in Fig. 5, Fig. 10 newly includes a confidentiality processing unit 460. The confidentiality processing unit 460 includes an encrypting unit 462 and a decrypting unit 463. The encrypting unit 462 inputs the transparent data 95 from the terminal IF unit 10, encrypts the input data to output to the radio communication unit 30 as the transparent data 96. On the other hand, the decrypting unit 463 inputs the transparent data 96 from the radio

communication unit 30, decrypts the input data to output to the terminal IF unit 10 as the transparent data 95. These processes of the confidentiality processing unit 460 are performed based on the control signal 99 from the IF unit 410. The control signal 99 is derived from the control signal 91.

5 Accordingly, the confidentiality processing unit 460 performs the confidentiality processing based on the control signal issued from the radio communication control unit 20. In Fig. 10, the data 92 is input/output using the parallel interface through bus. On the other hand, the transparent data 95 and 96 are input/output to/from the confidentiality processing unit 460

10 through the serial interface. As explained above, Fig. 10 shows a case in which two systems of input/output interface, that is, the parallel interface and the serial interface are provided in the confidentiality/integrity processing unit 40.

Fig. 11 shows a configuration in which the confidentiality processing unit 460 is added to the confidentiality/integrity processing unit 40 shown in Fig. 7. It is effective to have the configuration shown in Fig. 11 when the encrypting unit or the decrypting unit generates key streams to be XORed with the serial data as shown in Fig. 12.

15

As shown in Fig. 11, the transparent data 95 and 96 are input/output from/to the confidentiality processing unit 460 through the serial interface, and further, the serial data which is input/output through the serial interface includes multiplexed data of multiple channels. For example, when data of channel 2 is input as serial data after data of channel 1 is input, the encrypting unit 1 corresponding to the channel 1 generates a key stream

20

25 to output to a multiplexer 481, the encrypting unit 2 corresponding to the



channel 2 generates another key stream to output to the multiplexer 481, and the multiplexer 481 multiplexes these key streams into format the same as the data system of the data 95. The multiplexed key stream and the data sequence of the input data 95 are XORed by the XOR circuit 483. The confidentiality processing unit 460 performs the above operations based on the control signal 99, namely, the control signal 91 supplied from the radio communication control unit 20. By using the configuration of Fig. 11, the delay of the serial data is caused only by the operation of the XOR circuit 483, which enables the high speed processing.

Fig. 13 shows another configuration in which the confidentiality processing unit 420 and the confidentiality processing unit 460 of Fig. 10 are combined into one confidentiality processing unit 470.

The confidentiality processing unit 470 processes both of the data 92 input/output through the parallel interface and the data 95, 96 input/output through the serial interface. The confidentiality processing unit 420 and the confidentiality processing unit 460 are united into the confidentiality processing unit 470, so that the hardware resource can be reduced. The confidentiality processing unit 470 switches the process for the transparent data and the process for the non-transparent data based on the control signal 99, namely, the control signal 99 output from the radio communication control unit 20.

The above confidentiality/integrity processing unit 40 can be configured by the hardware. For example, the configuration can be implemented by FPGA or custom LSI. Further, the confidentiality/integrity processing unit 40 can be implemented by the software program. In case

the confidentiality/integrity processing unit 40 is implemented by the software program, CPU of the radio communication control unit 20 executes the software program.

Further, the confidentiality/integrity processing unit 40 can be implemented by a combination of the hardware and the software. For example, the confidentiality/integrity processing unit 40 can be implemented by DSP (Digital Signal Processor) and micro program or firmware program executed by the DSP.

Hereinafter, a concrete example will be explained with reference to Figs. 17 through 20.

Fig. 17 shows a configuration of the encryption module 51 (or decryption module 71) used for the encryption/decrypting unit 421.

The encryption module 51 includes a key scheduler 511 and a data randomizing unit 512. The key scheduler 511 inputs one key K and generates n extended keys ExtK1 through ExtKn. The data randomizing unit 512 generates a random number using a function F and an XOR circuit. The function F inputs the extended key and performs non-linear data transformation.

In the encryption module 51, various block cipher algorithm can be employed such as:

- (1) DES (Data Encryption Standard);
- (2) MISTY, which is the block cipher algorithm disclosed in the International Publication No. WO97/9705 (US Serial No. 08/83640);
- (3) KASUMI, which is the 64-bit block cipher technique based on the above block cipher algorithm MISTY and is determined to be employed as

International standard cipher for next generation cellular phone (IMT2000);  
and

(4) Camellia, which is the block cipher algorithm disclosed in the Japanese patent application No. 2000-64614 (filed on March 9, 2000).

- 5 Further, these block cipher algorithms such as DES, MISTY, KASUMI, and Camellia can be employed in the decryption module 71.

Fig. 18 shows the implementation form of the confidentiality/integrity processing unit 40.

Fig. 18 shows a case in which the confidentiality/integrity processing  
10 unit 40 is implemented inside FPGA, IC or LSI. Namely, the confidentiality/integrity processing unit 40 can be implemented by the hardware. Further, the confidentiality/integrity processing unit 40 can be also implemented by a print circuit board, which is not shown in the figure.

Fig. 19 shows a case in which the confidentiality/integrity processing  
15 unit 40 is implemented by the software.

The confidentiality/integrity processing unit 40 can be implemented by a cipher program 47. The cipher program 47 is stored in a ROM (Read Only Memory) 42 (an example of storage). The cipher program 47 can be stored in a RAM (Random Access Memory) or another storage such as a  
20 flexible disk or a fixed disk. Further, the cipher program 47 can be downloaded from a server computer. The cipher program 47 is functioned as a subroutine. The cipher program 47 is called for subroutine execution from an application program 46 stored in the RAM 45 as a subroutine call. In another way, the cipher program 47 can be activated by generation of an  
25 interrupt received at an interrupt control unit 43. A memory 55 can be a

part of the RAM 45. The application program 46 and the cipher program 47 are programs executed by the CPU 41.

Fig. 20 shows mechanism for calling the cipher program 47 by the application program 46 which is operated on the radio communication control unit 20.

The application program 46 calls the cipher program 47 using parameters of a key K, an initial value IV, plaintext data M, and ciphertext data C. The cipher program 47 inputs the key K, the initial value IV, and the plaintext data M and returns the ciphertext data C. If the cipher program 47 and the decryption program are the same, the cipher program 47 is called using parameters of the key K, the initial value IV, the ciphertext data C, and the plaintext data M.

Further, the cipher program 47 can be implemented by a digital signal processor and a program read and executed by the digital signal processor, though which is not shown in the figure. Namely, the cipher program 47 can be implemented by combination of the hardware and the software.

The above explanation referring to Figs. 18, 19, and 20 applies to the encryption, however, the decryption can be implemented in the same way.

The encryption system or the decryption system can be installed to an electronic devices. The system can be installed in all kinds of electronic devices, for example, a personal computer, facsimile machine, a cellular phone, a video camera, a digital camera, or a TV camera. In particular, the feature of the embodiment can be accomplished effectively when the data from multiple channels is encrypted/decrypted. Or the implementation of

the embodiment can be effective in case where data is received at random from multiple users and decrypted, or data for multiple users is generated at random and respectively encrypted in real time. Namely, the encryption/decryption of the above embodiment can be extremely effective when the number of apparatuses for encryption/decryption is small compared with the number of data kinds to be encrypted/decrypted. For example, the encryption/decryption of the above embodiment is highly effective when applied to a server computer which has to support many client computers or a base station or a line control unit which has to collect and distribute data from/to many cellular phones.

In the above example, the radio communication control unit 20 and the confidentiality/integrity processing unit 40 are connected with the parallel interface through the bus, however, the serial interface can be used for connecting the radio communication control unit 20 and the confidentiality/integrity processing unit 40. Further, in the above explanation, the terminal IF unit 10 and the confidentiality/integrity processing unit 40, the 30 and the confidentiality/integrity processing unit 40 are connected with the serial interface, however, the parallel interface can be used for processing at a higher speed instead of the serial interface.

In case of Figs. 9 and 10, the confidentiality processing unit 460 is provided inside the confidentiality/integrity processing unit 40, however, the confidentiality processing unit 460 can be provided independently from the confidentiality/integrity processing unit 40, and the confidentiality processing unit 460 can be placed between the terminal IF unit 10 and the radio communication unit 30.

### Industrial Applicability

As mentioned above, this implementation embodiment enables confidentiality/integrity processing in layer 2 or upper layers so that confidentiality processing is not performed in layer 1, therefore making it possible to determine the necessity of confidentiality/integrity processing based on data kinds.

For example, only confidentiality processing is performed on the transparent data, and both the confidentiality processing and the integrity processing are performed on the non-transparent data. In another way, it becomes possible to select to perform or not the confidentiality processing and the integrity processing in case of processing the non-transparent data.

Further, according to the above embodiment, multiple confidentiality processing units and multiple integrity processing units are provided inside the confidentiality/integrity processing unit according to the number of channels or the amount of the data, enabling high speed data processing by the simultaneous parallel processing.

## Claims

1. A radio communication apparatus comprising:  
a terminal interface unit for inputting data;  
a radio communication control unit for inputting the data input by  
5 the terminal interface unit, for processing the data based on protocol, and  
outputting the data;  
a confidentiality/integrity processing unit for inputting a control  
signal and data from the radio communication control unit, performing at  
least one of encryption of the data as confidentiality processing and  
10 generation of a message authentication code for detecting tampered data as  
integrity processing on the data input, and outputting the data processed to  
the radio communication control unit; and  
a radio communication unit for inputting, modulating, and sending  
the data output from the radio communication control unit.
- 15 2. The radio communication apparatus of claim 1,  
wherein the confidentiality/integrity processing unit inputs the  
control signal from the radio communication control unit and selectively  
inputs the data from the terminal interface unit based on the control signal  
input, and  
20 wherein the confidentiality/integrity processing unit performs  
confidentiality processing on the data input and outputs the data which has  
been performed confidentiality processing to the radio communication unit.
3. The radio communication apparatus of claim 2,  
wherein the terminal interface unit outputs transparent data and  
25 non-transparent data, and

wherein the radio communication control unit inputs the non-transparent data from the terminal interface unit, makes the confidentiality/integrity processing unit process the non-transparent data based on protocol, and

5        wherein the radio communication control unit controls the transparent data to be transferred from the terminal interface unit to the confidentiality/integrity processing unit to perform the confidentiality processing.

4.        The radio communication apparatus of claim 1, wherein the  
10        confidentiality/integrity processing unit is connected to the radio communication control unit via parallel interface.

5.        The radio communication apparatus of claim 1, wherein the confidentiality/integrity processing unit is connected to the terminal interface unit with serial interface and connected to the radio  
15        communication unit with serial interface.

6.        The radio communication apparatus of claim 1, wherein the confidentiality/integrity processing unit further includes:

        a confidentiality processing unit including an encrypting unit for encrypting the data input; and

20        an integrity processing unit having a message authentication code appending unit for appending a message authentication code to the data input.

7.        The radio communication apparatus of claim 6, wherein the confidentiality/integrity processing unit includes multiple encrypting units.

25        8.        The radio communication apparatus of claim 6, wherein the

09926079-082701



confidentiality/integrity processing unit includes multiple message authentication code appending units.

9. The radio communication apparatus of claim 6, wherein the confidentiality processing unit and the integrity processing unit form one module which inputs the control signal and the data from the radio communication control unit, and the module performs at least one of the confidentiality processing and the integrity processing on the data input based on the control signal input.

10. A radio communication apparatus comprising:  
a radio communication unit for receiving and demodulating data;  
a radio communication control unit for inputting data demodulated by the radio communication unit, processing the data based on protocol, and outputting the data processed;  
a confidentiality/integrity processing unit for inputting a control signal and the data from the radio communication control unit, based on the control signal input performing at least one of confidentiality processing of decrypting the data and integrity processing of detecting tampered data, and outputting the data processed to the radio communication control unit;  
a terminal interface unit for inputting the data processed from the radio communication control unit and outputting the data.

11. The radio communication apparatus of claim 10,  
wherein the confidentiality/integrity processing unit inputs the control signal from the radio communication control unit and selectively inputs the data from the radio communication unit based on the control signal input, and

wherein the confidentiality/integrity processing unit performs the confidentiality processing on the data input and outputs the data processed to the terminal interface unit.

12. The radio communication apparatus of claim 11,

5 wherein the radio communication unit outputs transparent data and non-transparent data,

wherein the radio communication control unit inputs the non-transparent data from the radio communication unit and makes the confidentiality/integrity processing unit process the non-transparent data  
10 based on protocol, and

wherein the radio communication control unit controls the transparent data to be transferred from the radio communication unit to the confidentiality/integrity processing unit to perform the confidentiality processing.

15 13. The radio communication apparatus of claim 10, wherein the confidentiality/integrity processing unit is connected to the radio communication control unit with a parallel interface.

14. The radio communication apparatus of claim 11, wherein the confidentiality/integrity processing unit is connected to the terminal  
20 interface unit with a serial interface, and connected to the radio communication unit with a serial interface.

15. The radio communication apparatus of claim 10, wherein the confidentiality/integrity processing unit includes:

a confidentiality processing unit having a decrypting unit for  
25 decrypting the data input; and

09926078.002701

an integrity processing unit having an integrity verification unit for verifying an integrity of the data input using a message authentication code appended to the data input.

16. The radio communication apparatus of claim 15, wherein the  
5 confidentiality processing unit includes multiple decrypting units.

17. The radio communication apparatus of claim 15, wherein the integrity processing unit includes multiple integrity verification units.

18. The radio communication apparatus of claim 15, wherein the confidentiality processing unit and the integrity processing unit form one  
10 module which inputs the control signal and the data from the radio communication control unit, and wherein the module, based on the control signal input, performs at least one of processes of the confidentiality processing unit and the integrity processing unit on the data input.

19. A radio communication apparatus for wireless data communication  
15 comprising:

a terminal interface unit for data input/output;

a radio communication control unit for processing the data based on protocol;

a radio communication unit for wireless data communication; and

20 a confidentiality/integrity processing unit, provided among the terminal interface unit, the radio communication control unit, and the radio communication unit, which performs at least one of confidentiality processing for encrypting/decrypting data and integrity processing for detecting tampered data on the data input/output from/to the radio  
25 communication control unit, encrypts the data from the terminal interface

unit to the radio communication unit, and decrypts the data from the radio communication unit to the terminal interface unit.

20. The radio communication apparatus of claim 19, wherein the confidentiality/integrity processing unit includes a confidentiality processing unit for performing a confidentiality processing on the data input, and an integrity processing unit for performing an integrity processing on the data input, separately.

21. The radio communication apparatus of claim 19, wherein the confidentiality processing unit separately includes an encrypting unit for encrypting the data from the terminal interface unit to the radio communication unit, and a decrypting unit for decrypting the data from the radio communication unit to the terminal interface unit.

22. The radio communication apparatus of claim 19, wherein the integrity processing unit separately includes a message authentication code appending unit for appending a message authentication code to the data input for performing an integrity processing, and an integrity verification unit for verifying an integrity of the data input using the message authentication code appended to the data input.

23. The radio communication apparatus of claim 19, wherein the communication apparatus is a portable mobile phone.

24. The radio communication apparatus of claim 6, wherein the confidentiality processing unit and the integrity processing unit employ same encryption algorithm.

25. The radio communication apparatus of claim 15, wherein the confidentiality processing unit and the integrity processing unit employ

09926078-082701  
T02280-8209260

same encryption algorithm.

26. The radio communication apparatus of claim 20, wherein the confidentiality processing unit and the integrity processing unit employ same encryption algorithm.

5 27. The radio communication apparatus of claim 1, wherein the communication apparatus is a cellular phone.

28. The radio communication apparatus of claim 10, wherein the radio communication apparatus is a cellular phone.

29. The radio communication apparatus of claim 19, wherein the  
10 communication apparatus is a cellular phone.

30. The radio communication apparatus of claim 1, wherein the radio communication apparatus is a radio station for sending/receiving data to/from a mobile station.

31. The radio communication apparatus of claim 10, wherein the radio  
15 communication apparatus is a radio station for sending/receiving data to/from a mobile station.

32. The radio communication apparatus of claim 19, wherein the radio communication apparatus is a radio station for sending/receiving data to/from a mobile station.

20 33. The radio communication apparatus of claim 30, wherein the radio station is either of a base transceiver station and a radio network controller.

34. The radio communication apparatus of claim 31, wherein the radio station is either of a base transceiver station and a radio network controller.

35. The radio communication apparatus of claim 32, wherein the radio  
25 station is either of a base transceiver station and a radio network controller.

0926078.032701

36. A radio communication method comprising:
- a terminal interface step for inputting data;
  - a radio communication control step for inputting the data input by the terminal interface step and for processing the data based on protocol and outputting the data;
  - a confidentiality/integrity processing step for inputting a control signal and data from the radio communication step, performing at least one of encryption of the data as confidentiality processing and generation of a message authentication code for detecting tampered data as integrity processing on the data input, and outputting the data processed to the radio communication control step; and
  - a radio communication step for inputting, modulating, and sending the data output from the radio communication control step.
37. A radio communication method comprising:
- a radio communication step for receiving and demodulating data;
  - a radio communication control step for inputting data demodulated by the radio communication step, processing the data based on protocol, and outputting the data processed;
  - a confidentiality/integrity processing step for inputting a control signal and the data from the radio communication control step, based on the control signal input performing at least one of confidentiality processing of decrypting the data and integrity processing of detecting tampered data, and outputting the data processed to the radio communication control step; and
  - a terminal interface step for inputting the data processed from the radio communication control step and outputting the data.

09926078-082704

38. A radio communication method for wireless data communication comprising:

a terminal interface step for data input/output;

5 a radio communication control step for data processing based on protocol;

a radio communication step for wireless data communication; and

10 a confidentiality/integrity processing step, provided among the terminal interface step, the radio communication control step, and the radio communication step, and which performs at least one of confidentiality processing for encrypting/decrypting data and integrity processing for detecting tampered data on the data input/output from/to the radio communication control step, encrypts the data transferred from the terminal interface step to the radio communication step, and decrypts the data transferred from the radio communication step to the terminal interface  
15 step.

092603 08201  
T0230 340266

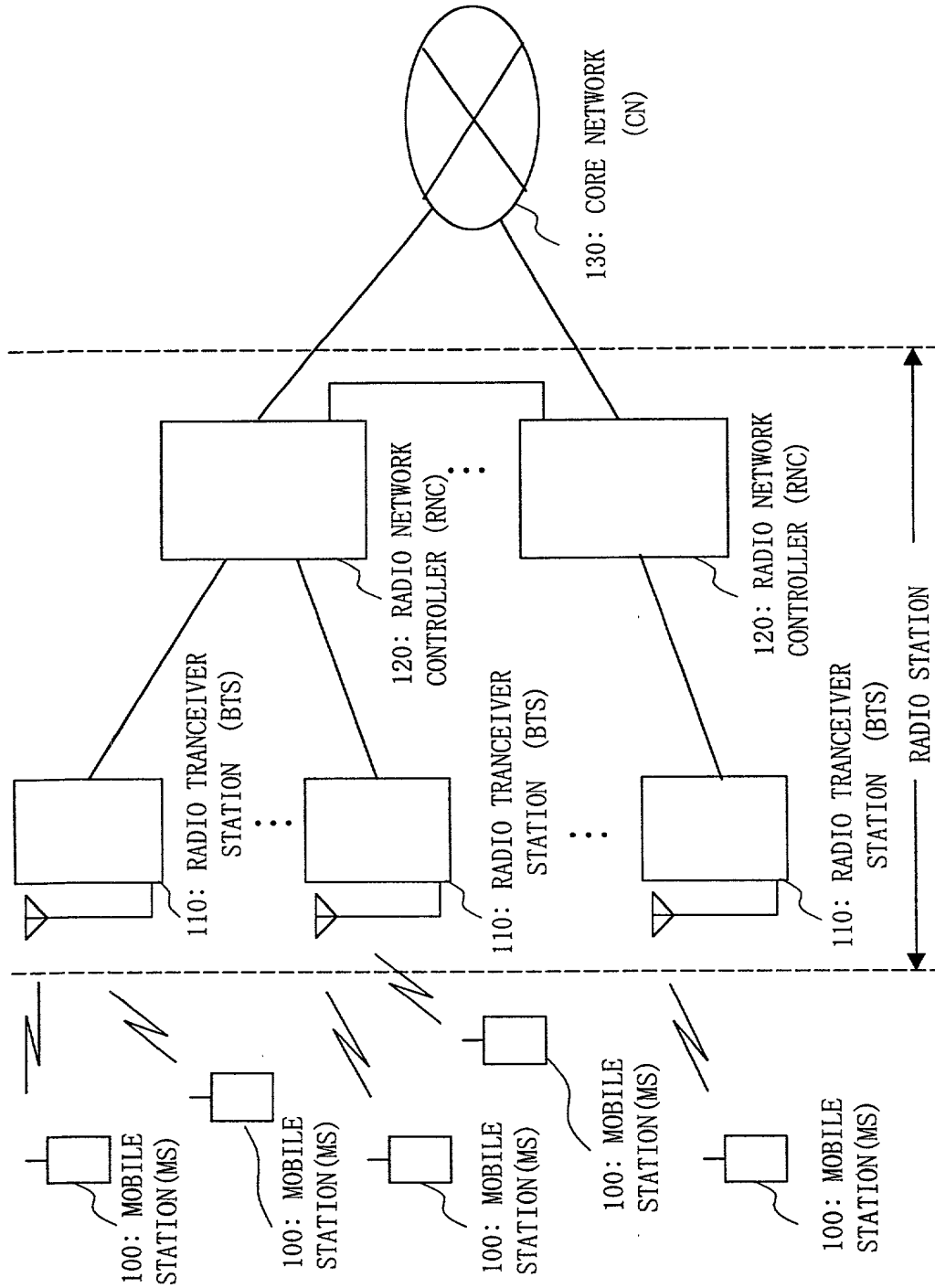
## Abstract

The present invention aims to provide a mobile station (MS) 100 which can perform confidentiality processing and integrity processing on data layer 2 or upper. A confidentiality/integrity processing unit 40 is provided among a terminal IF unit 10, a radio communication control unit 20, and a radio communication unit 30. The confidentiality/integrity processing unit 40 performs only the confidentiality processing on transparent data such as speech data transferred between the terminal IF unit 10 and the radio communication unit 30. The confidentiality/integrity processing unit 40 performs the confidentiality processing or/and the integrity processing on non-transparent data transferred to/from the radio communication control unit 20. The confidentiality/integrity unit 40 selectively performs the confidentiality processing or the integrity processing on the data of layer 2 or upper output from the radio communication unit 30 based on the data kind.

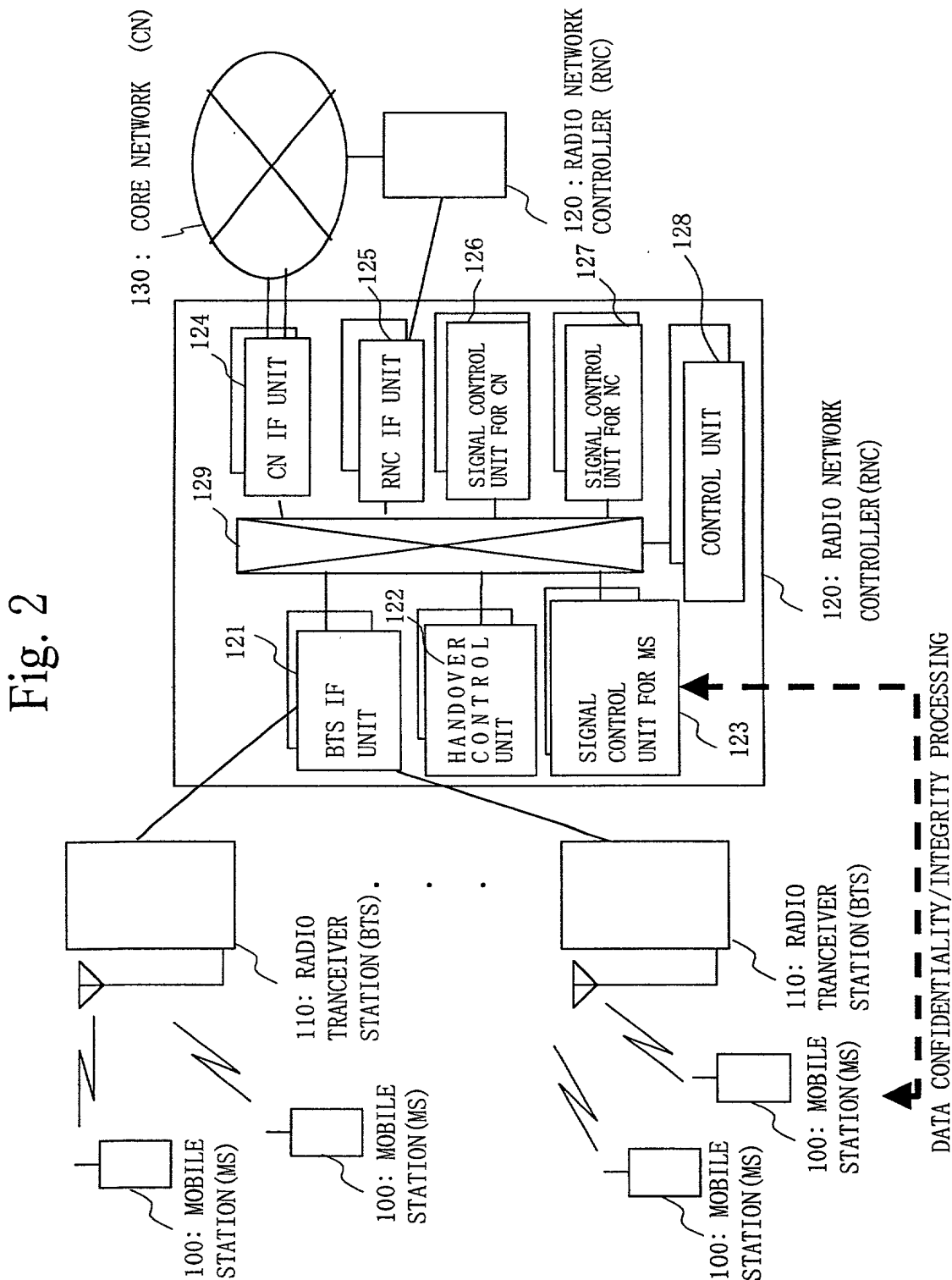


1 / 24

Fig. 1

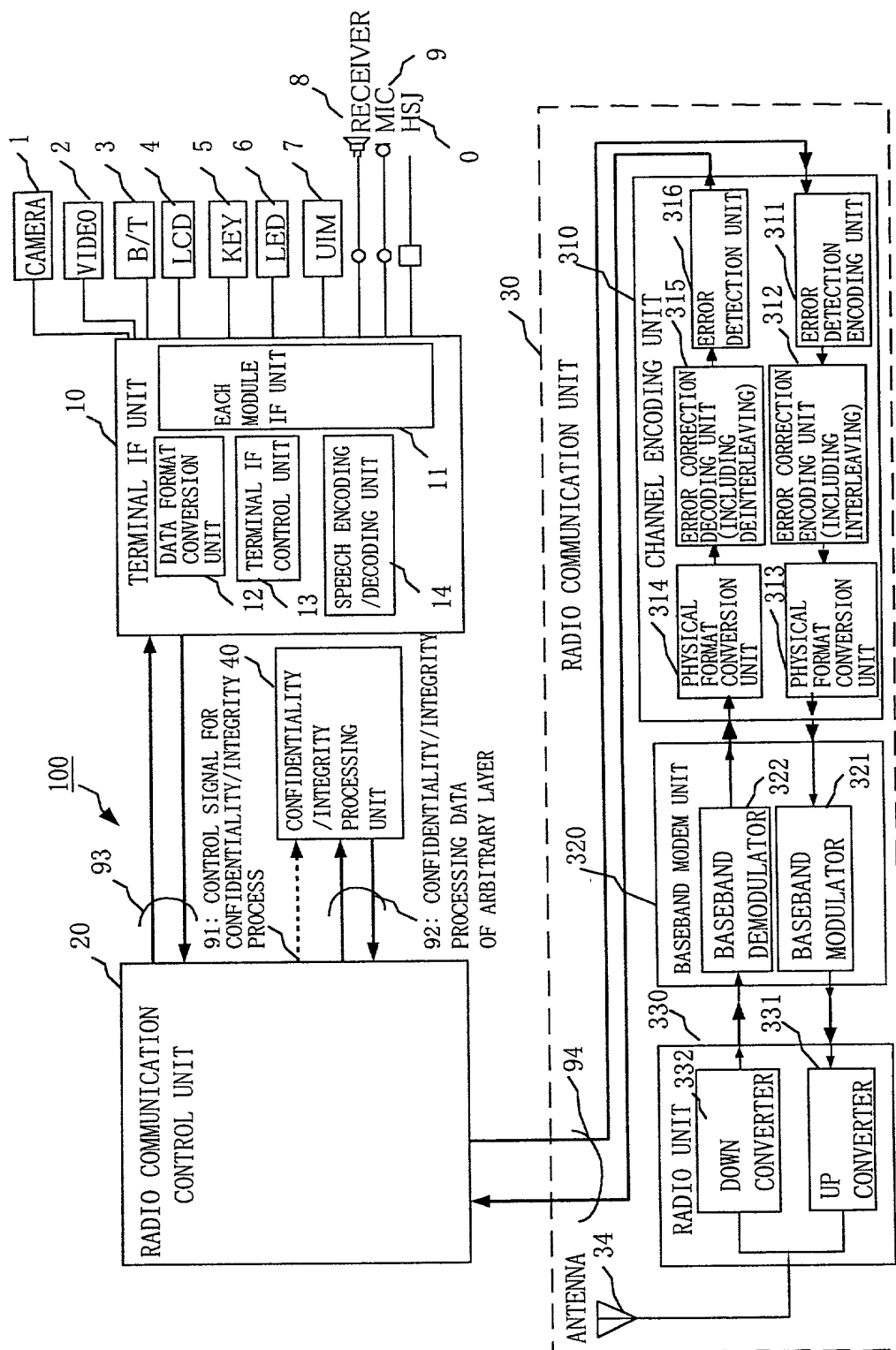


2 / 24



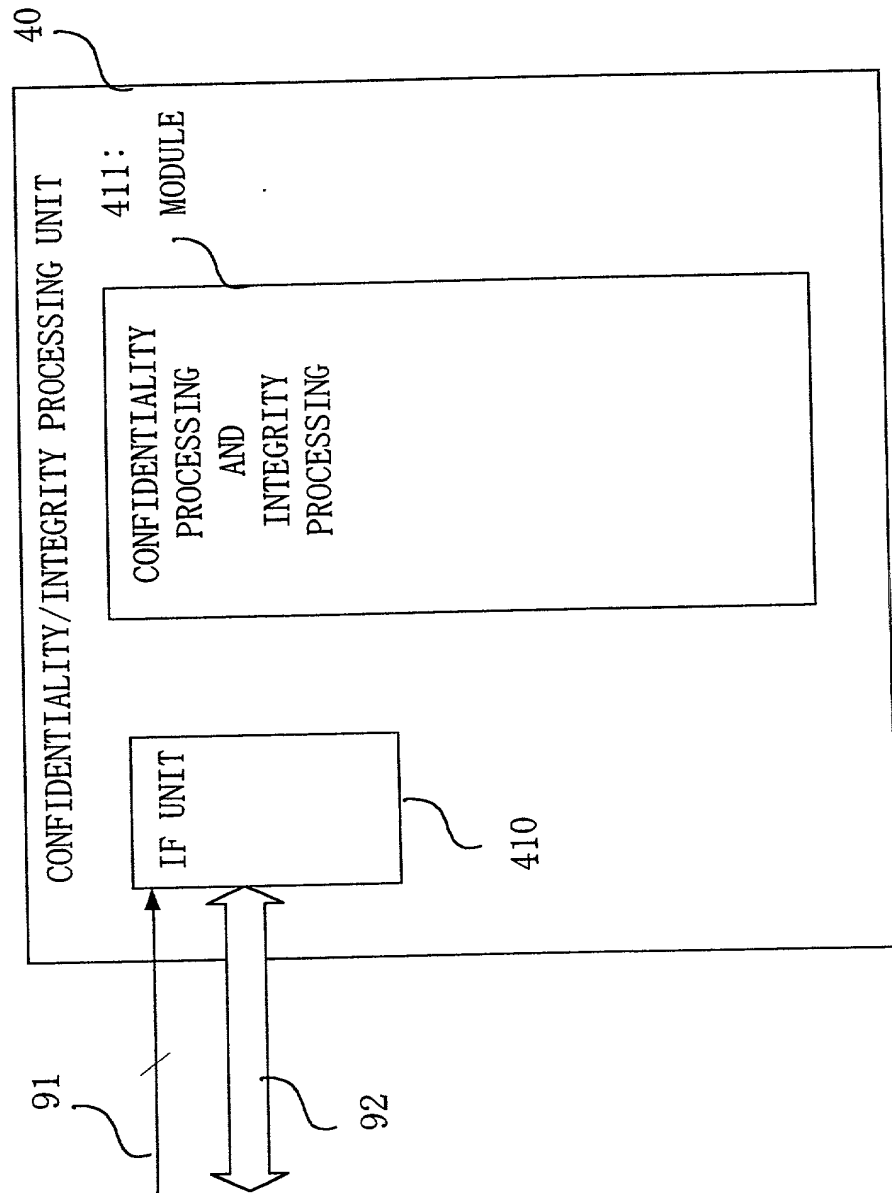
3 / 24

Fig. 3



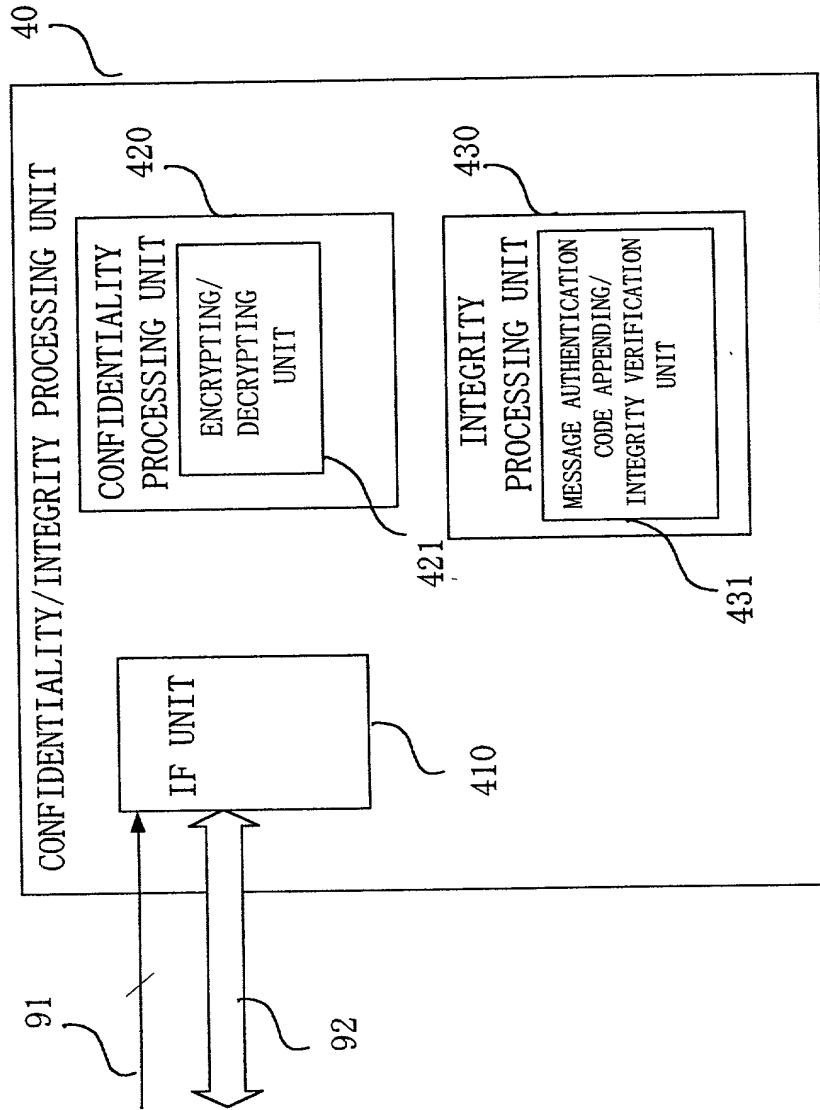
4 / 24

Fig. 4



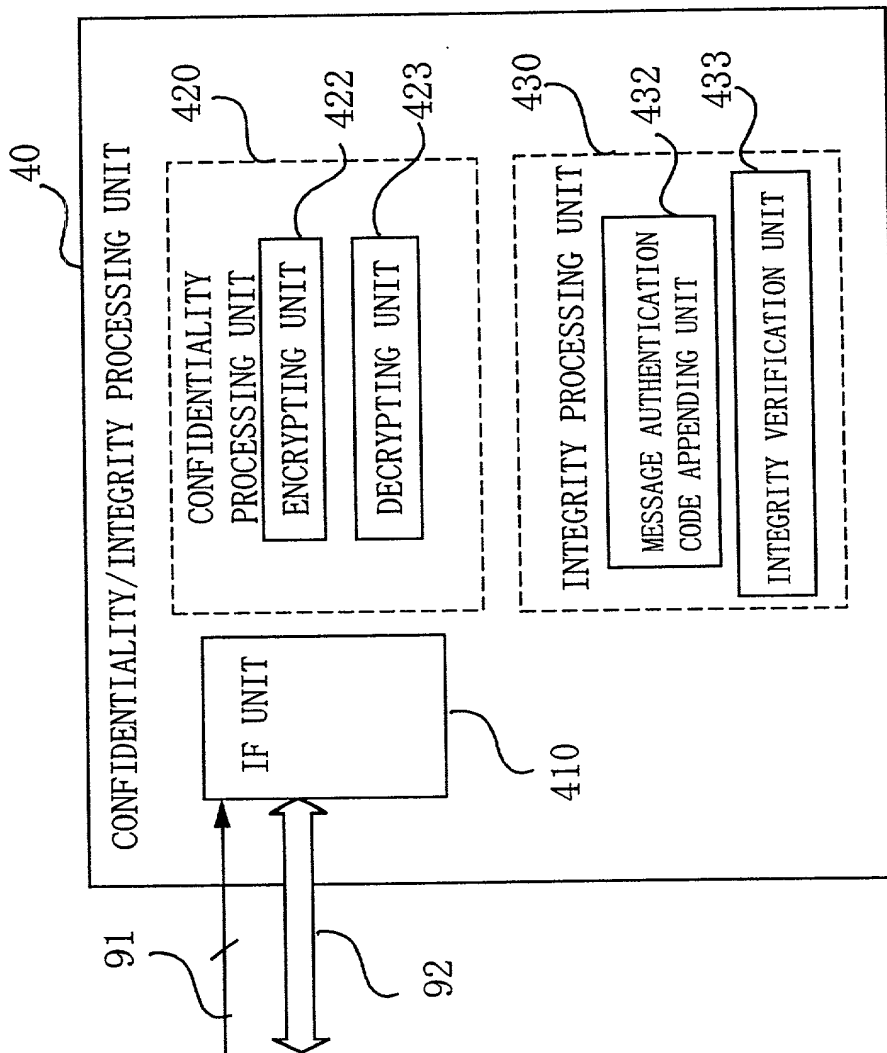
5 /24

Fig. 5



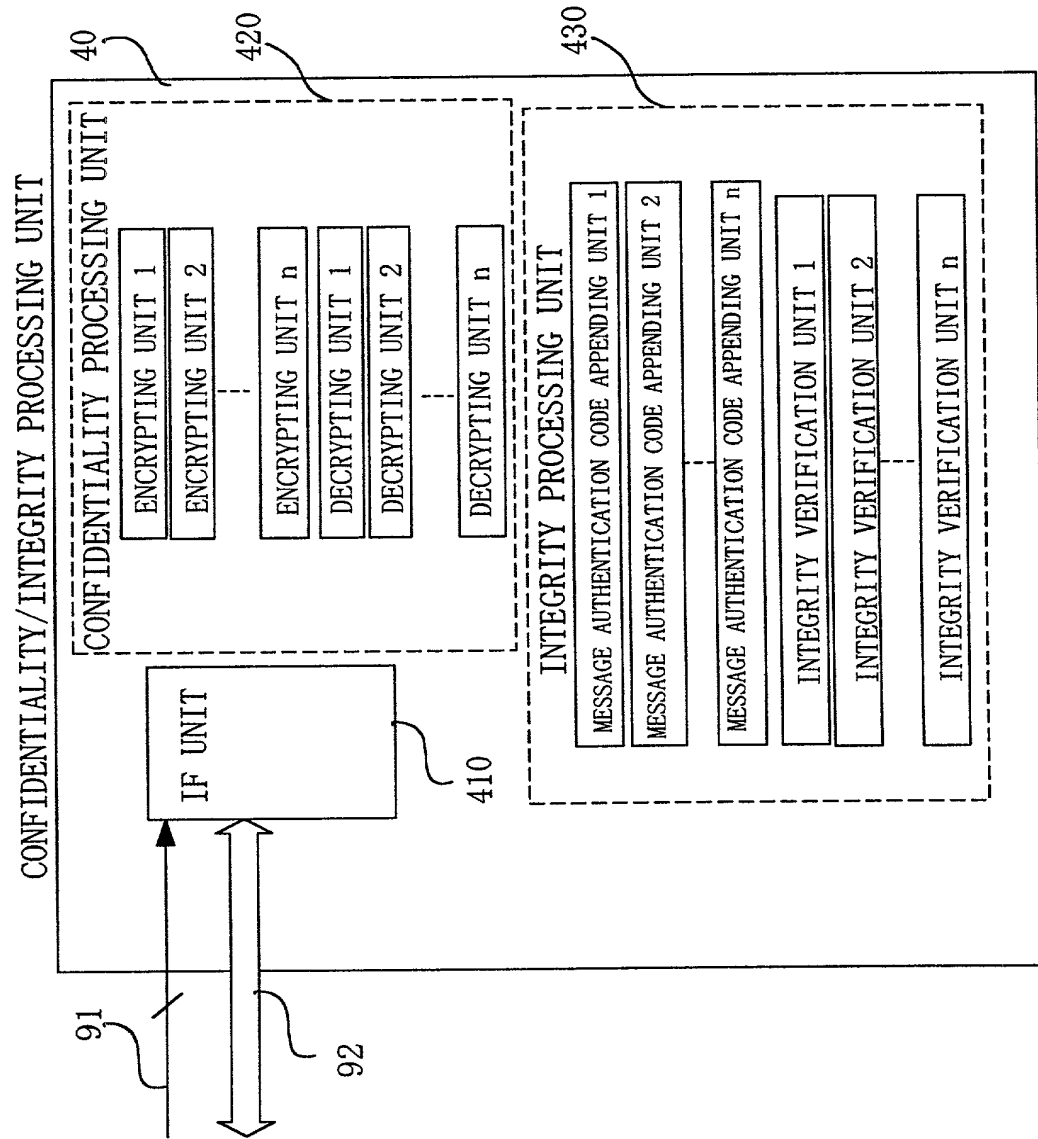
6 / 24

Fig. 6



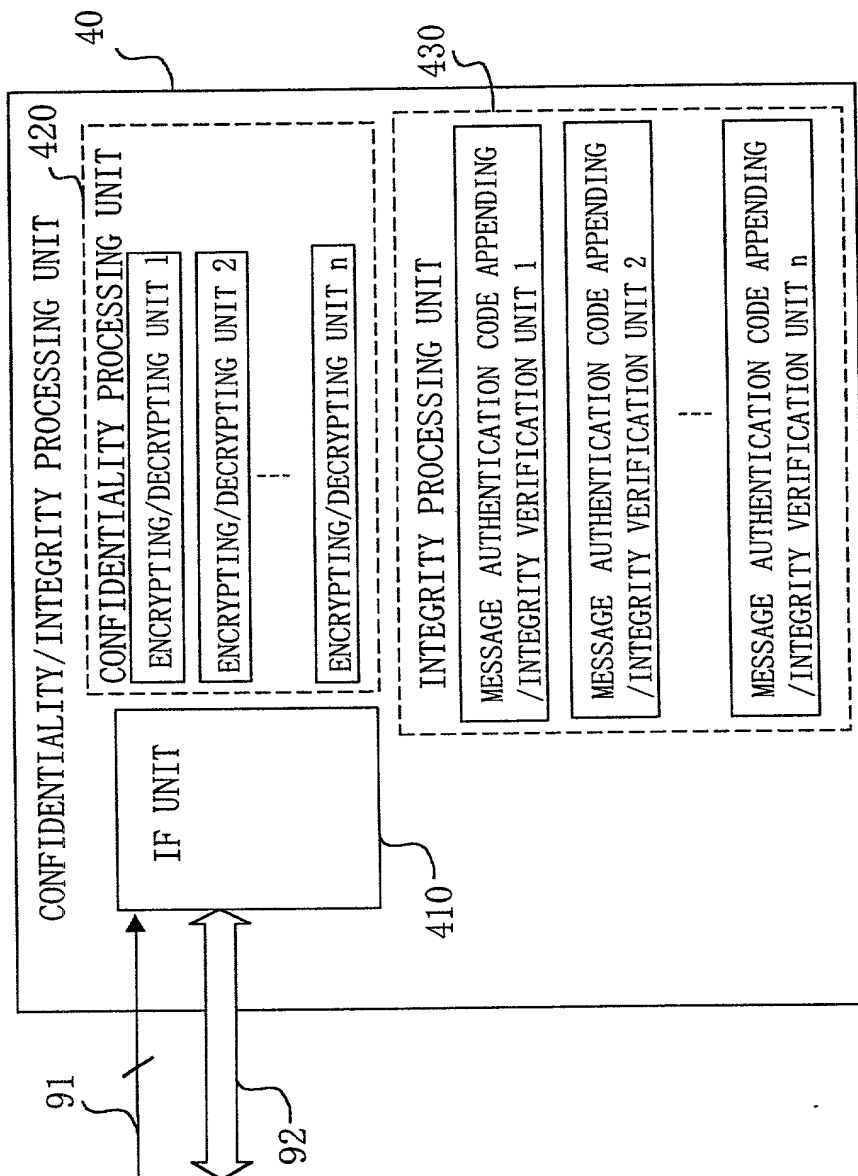
7 / 24

Fig. 7



8 / 24

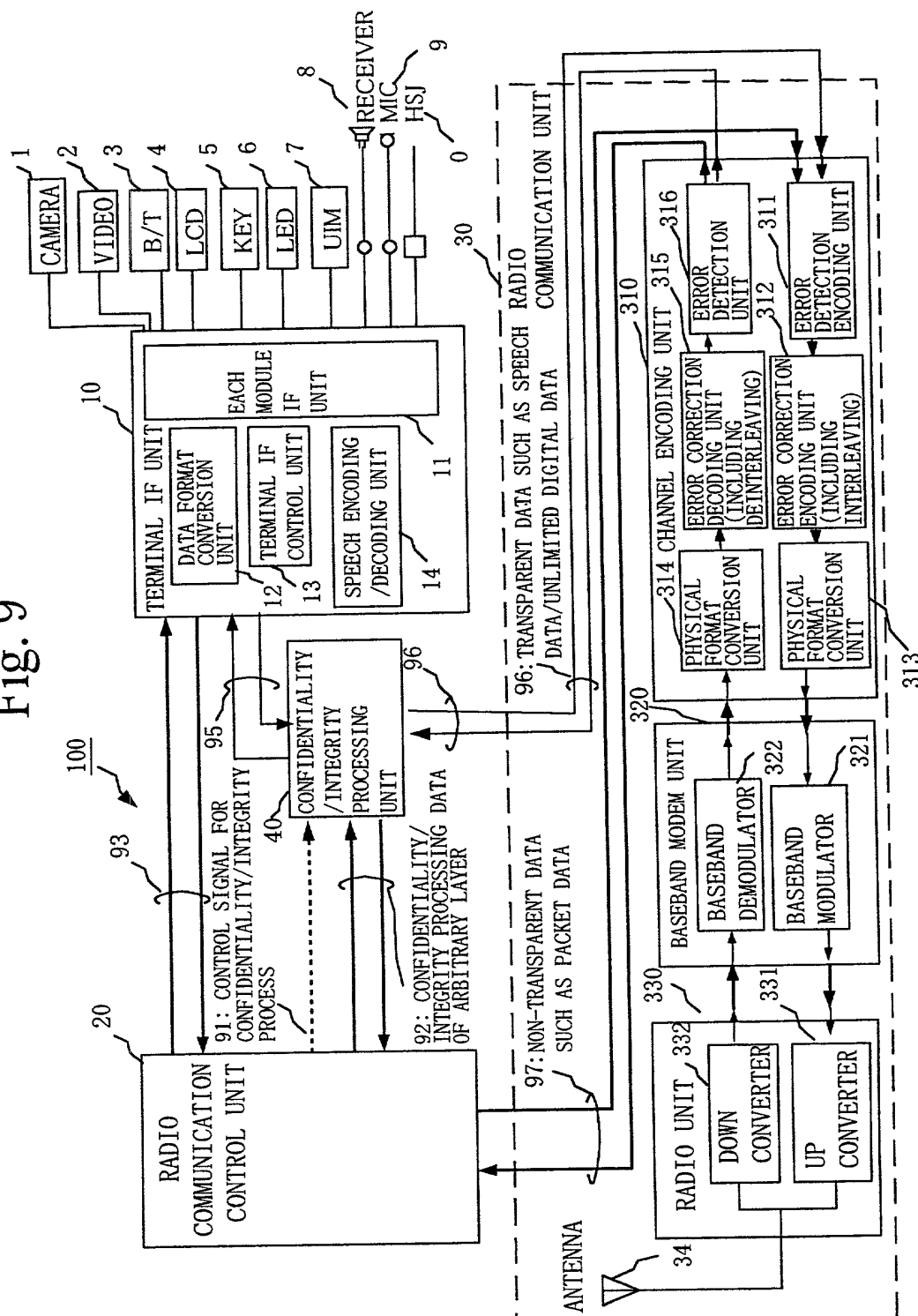
Fig. 8





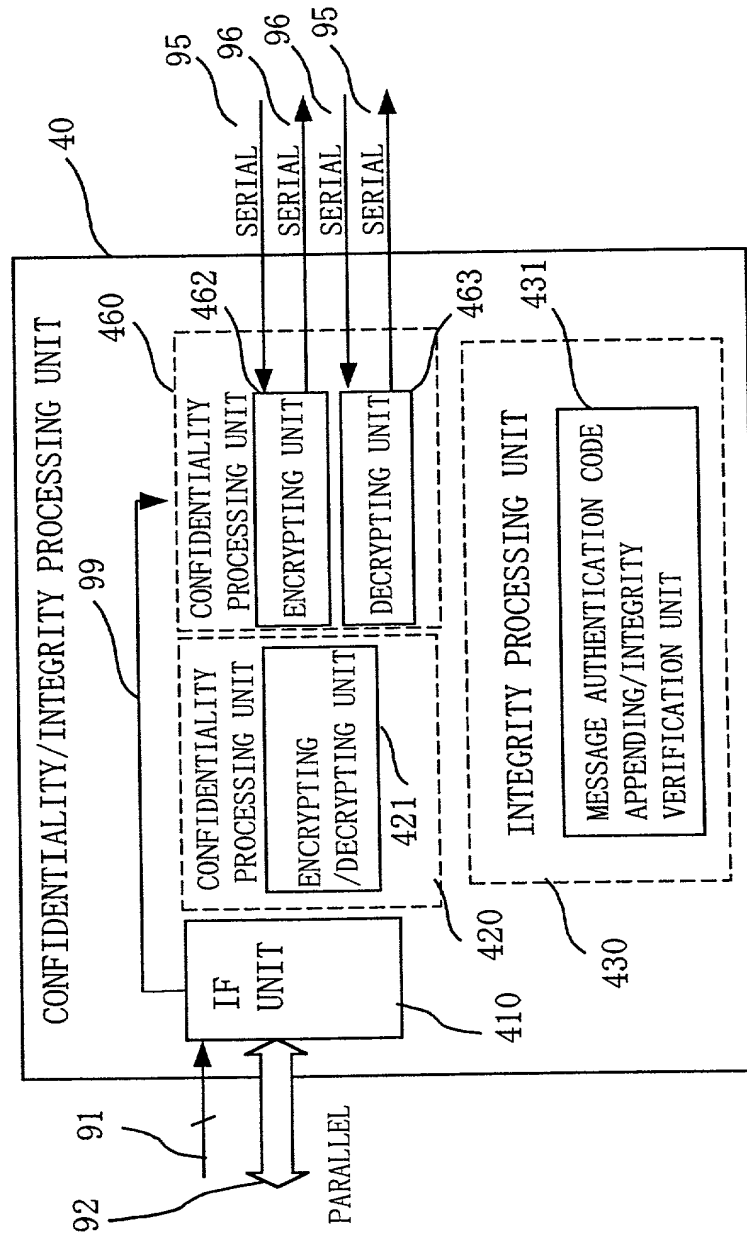
9 / 24

Fig. 9



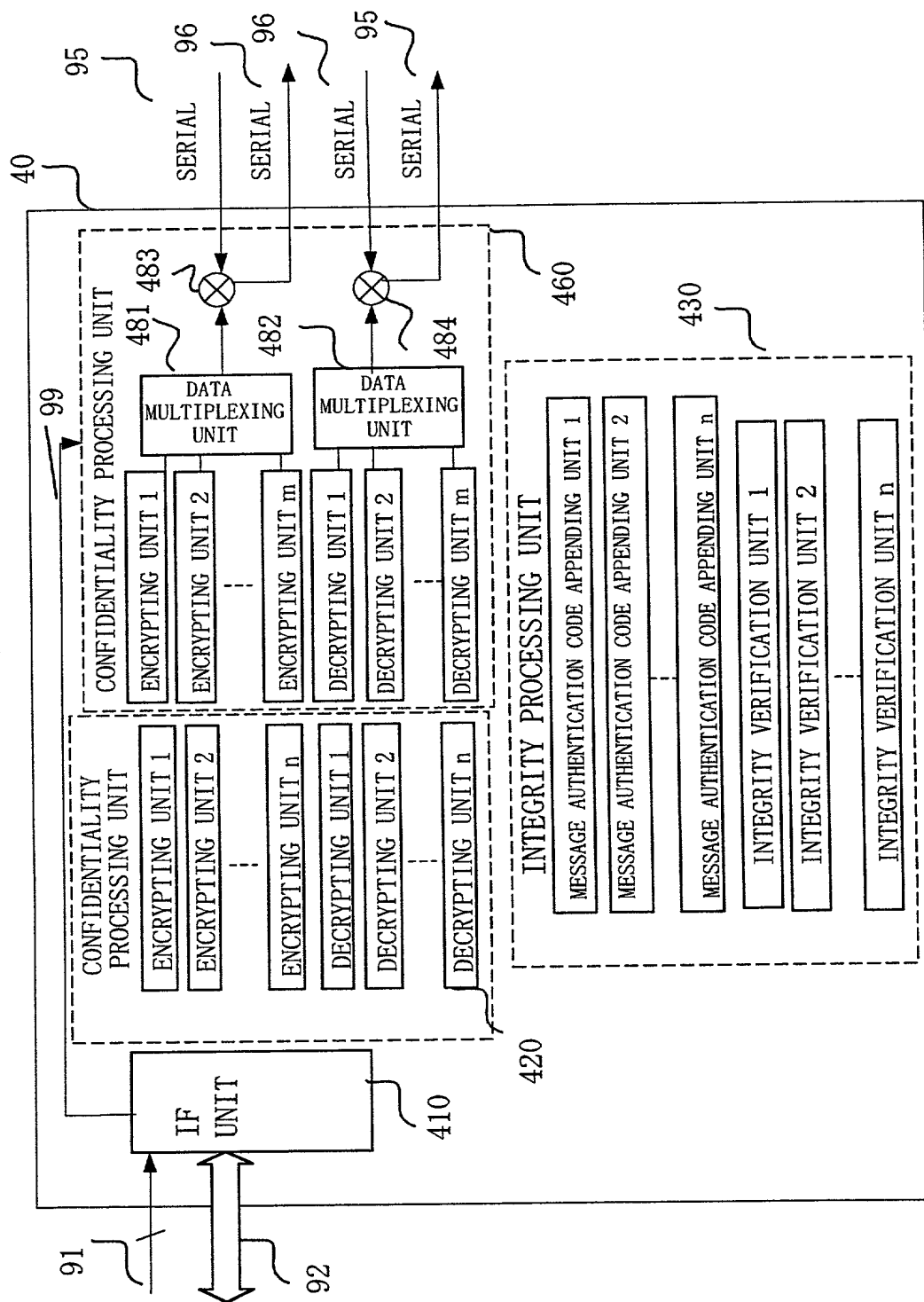
10 / 24

Fig. 10



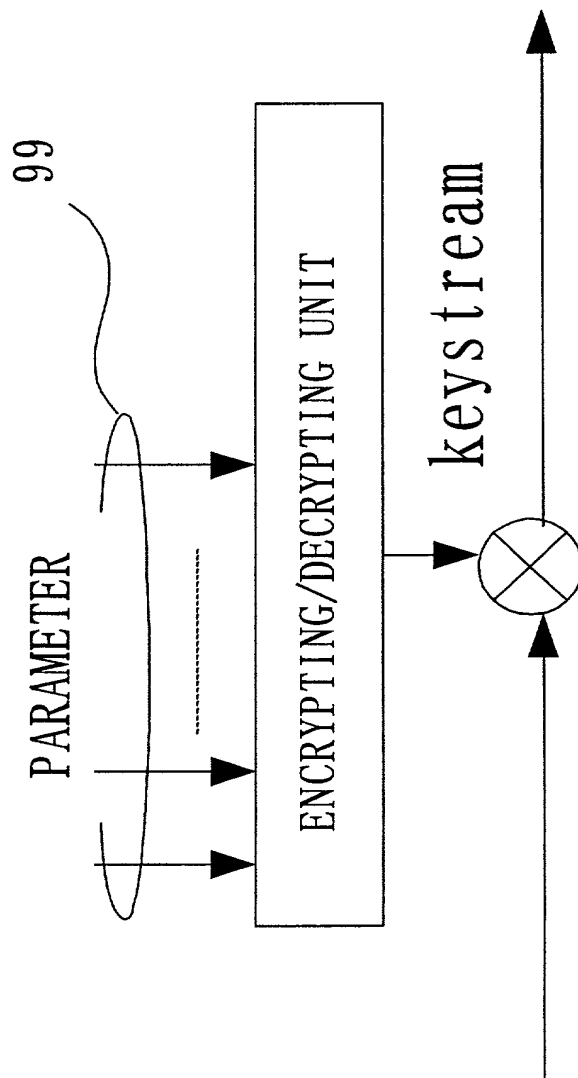
11 / 24

Fig.11



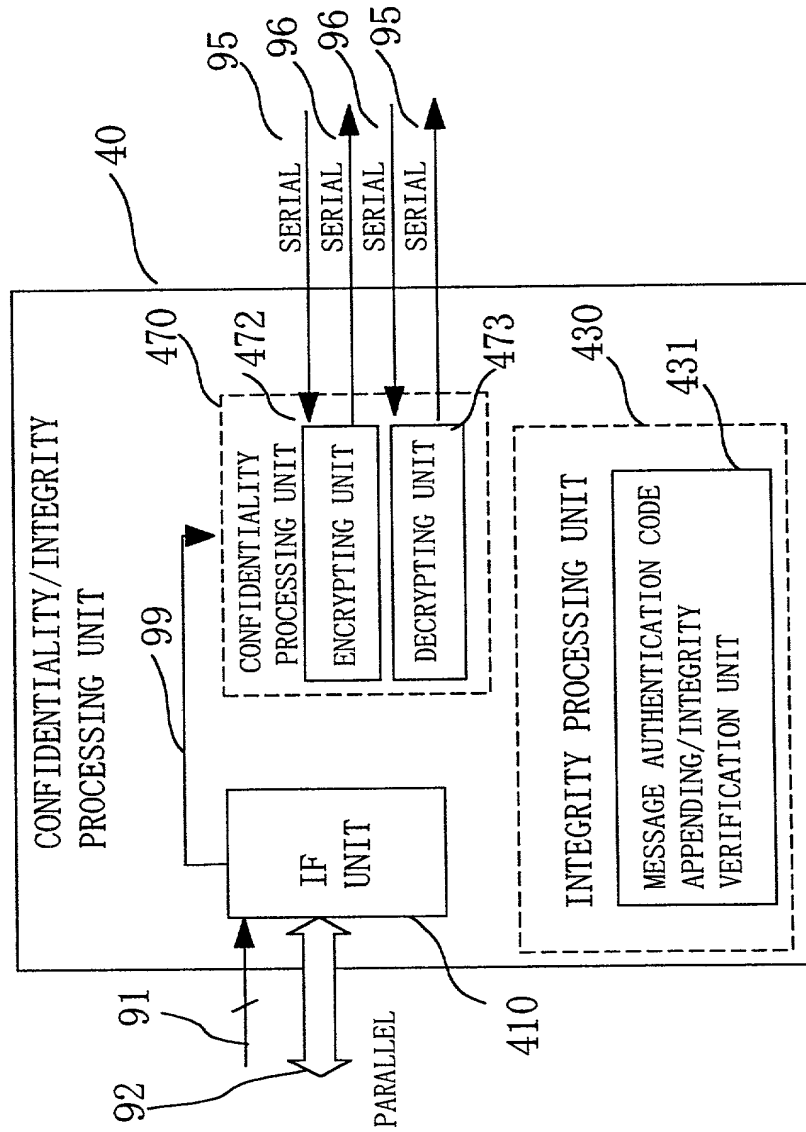
12 / 24

Fig. 12



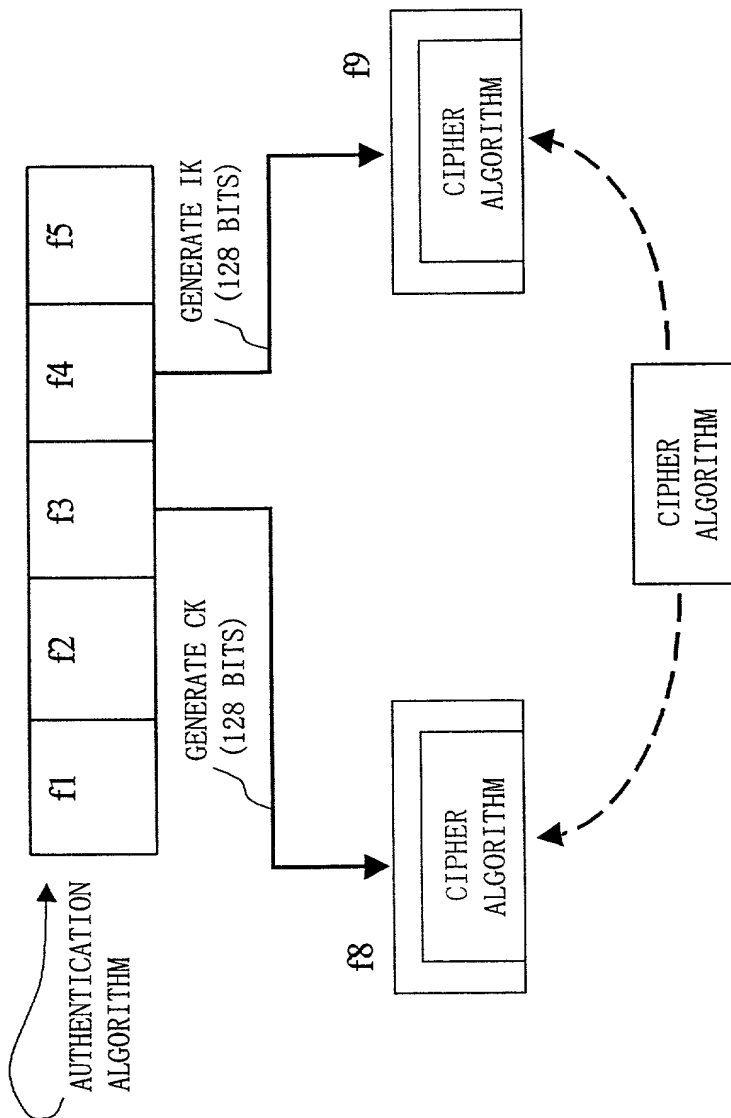
13 / 24

Fig.13



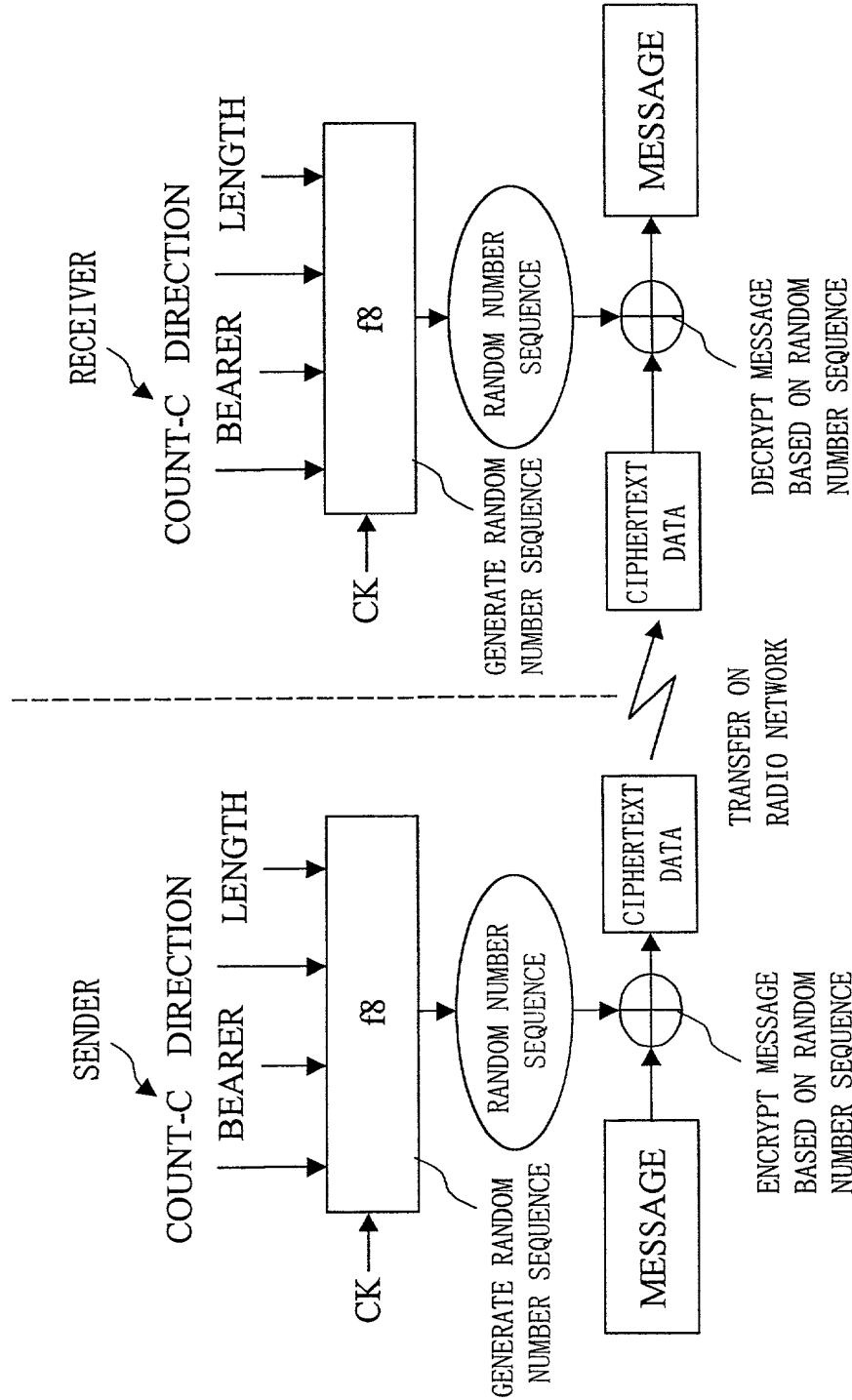
14 / 24

Fig. 14



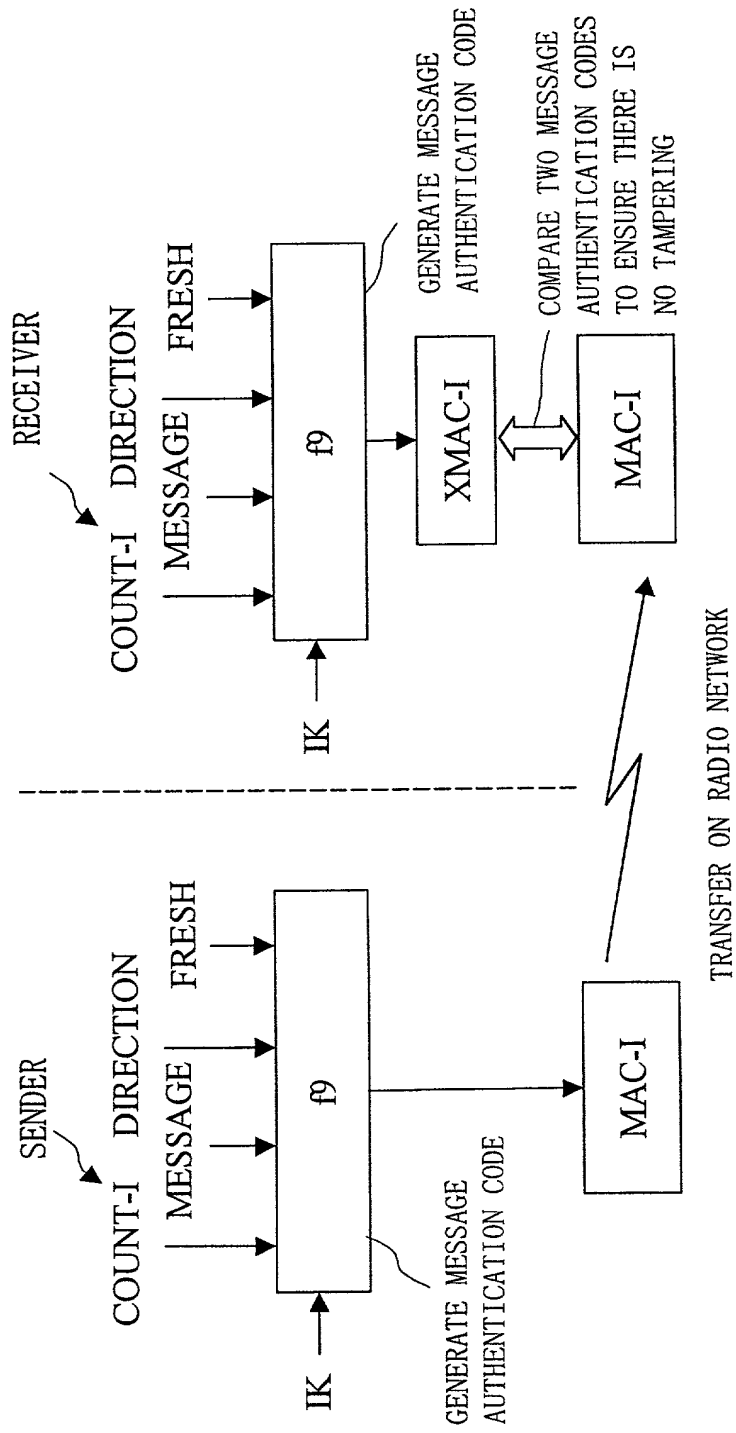
15 / 24

Fig. 15



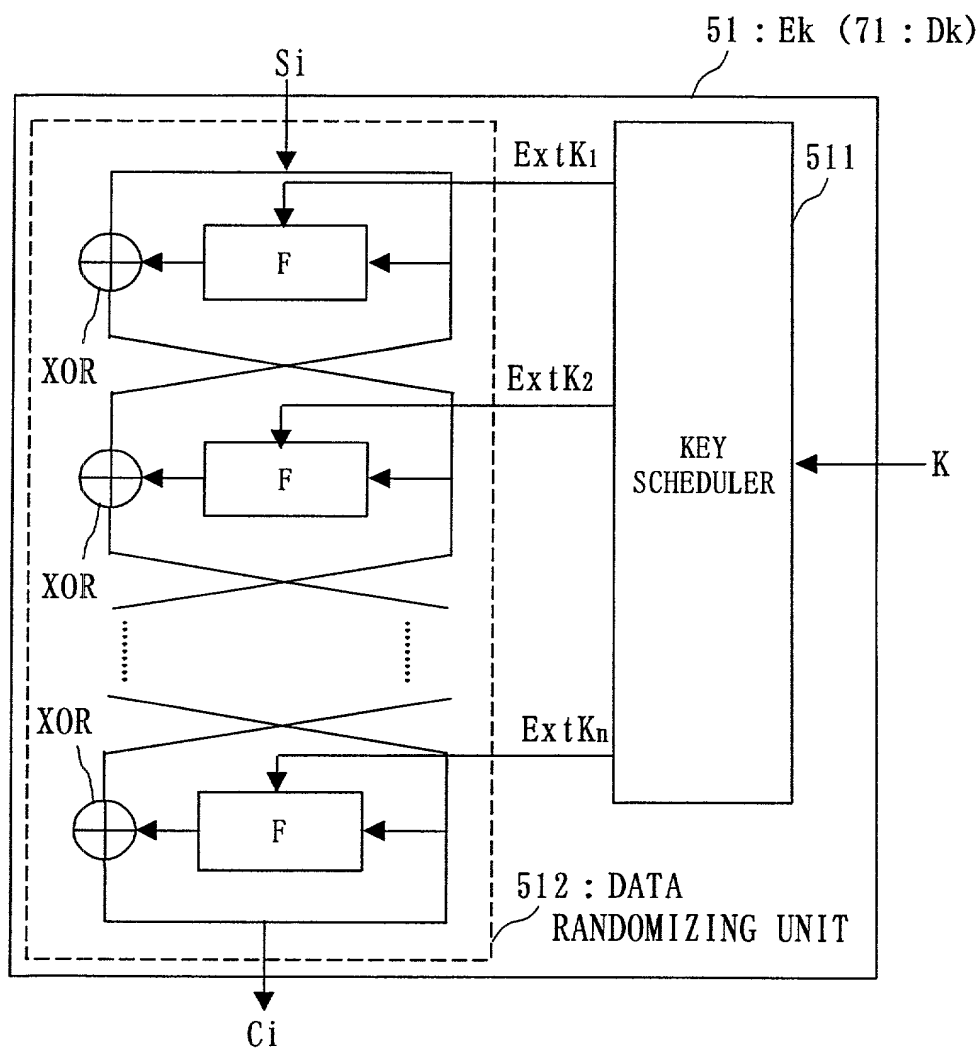
16 / 24

Fig. 16

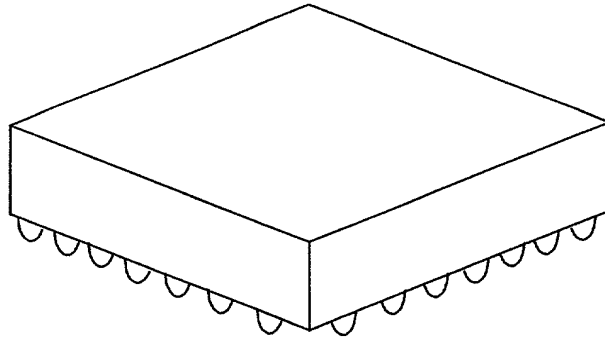




17/24  
Fig. 17



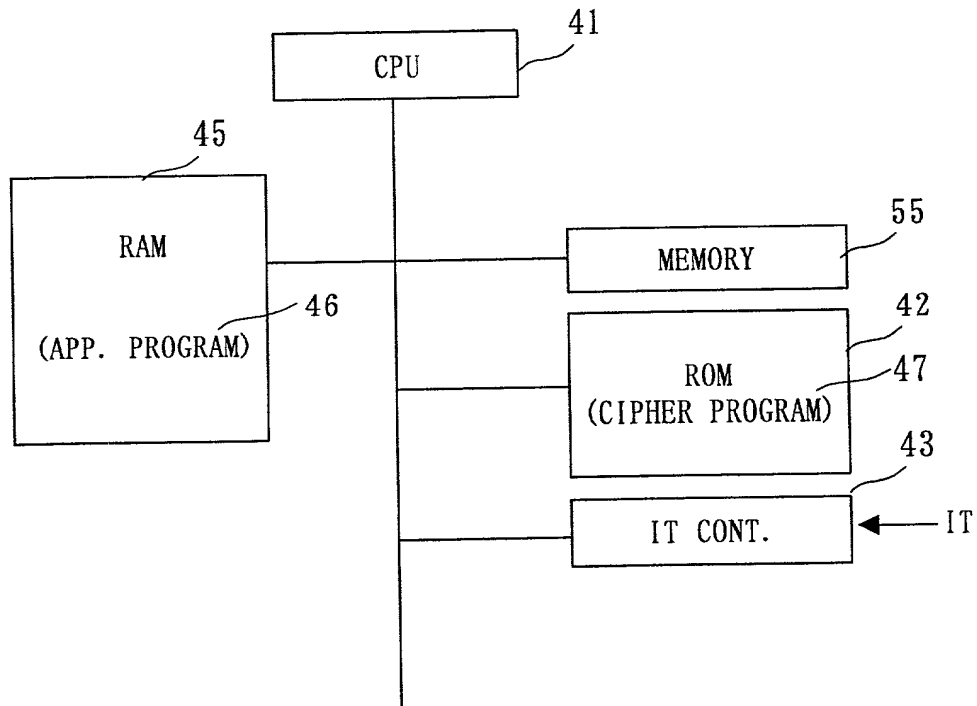
18/24  
Fig. 18



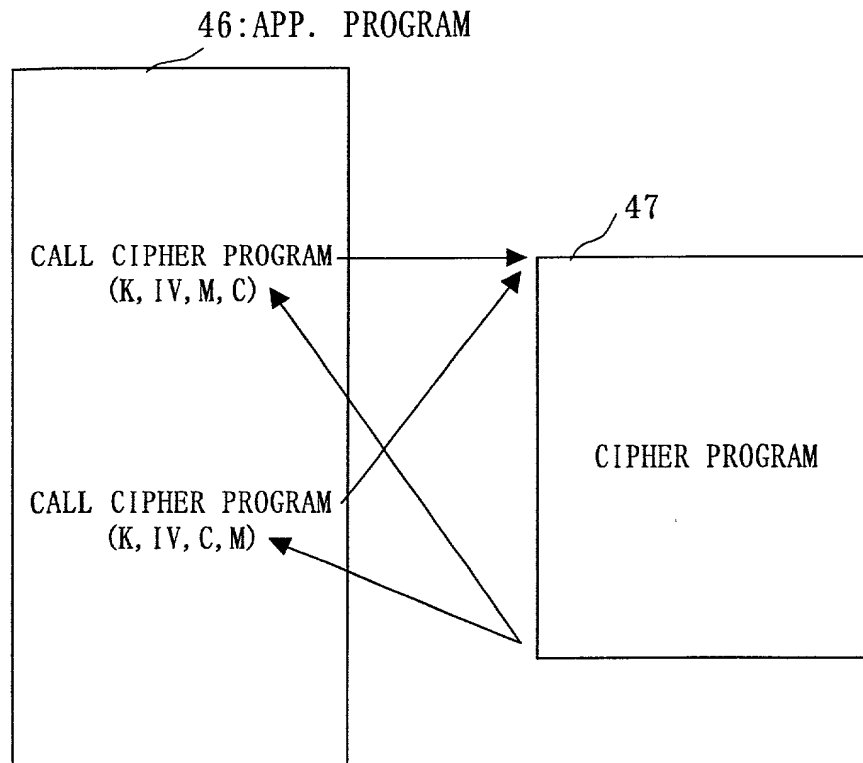
09/926078-08901  
T.0280-82092660

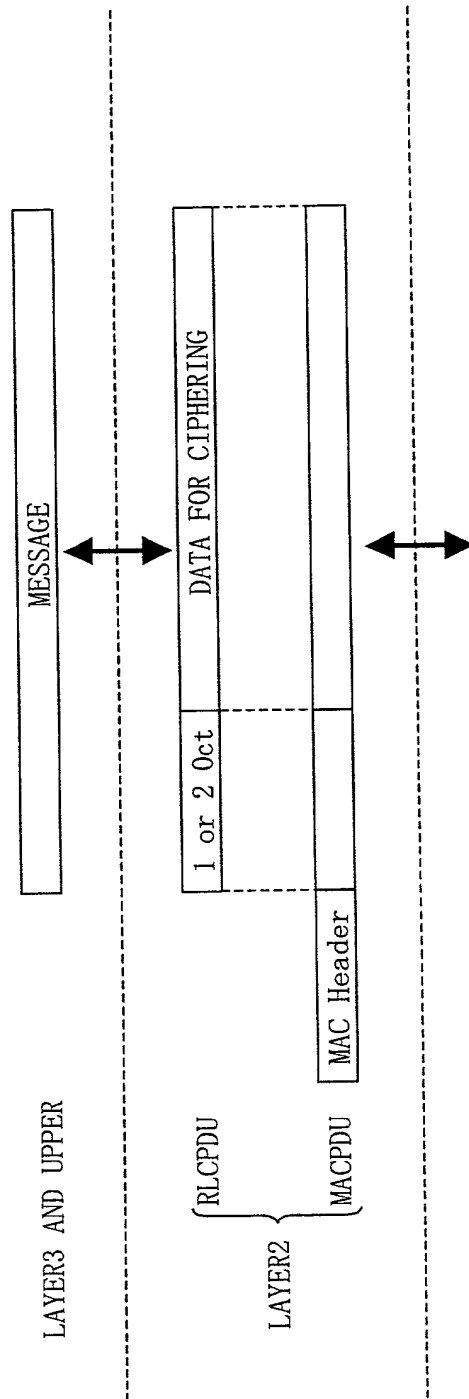
19/24

Fig. 19



20/24  
Fig. 20



21/24  
Fig. 21

22/24  
Fig. 22

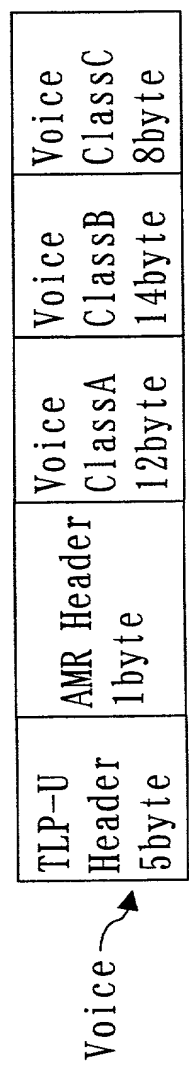
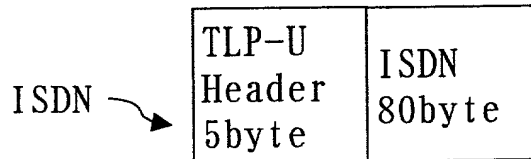


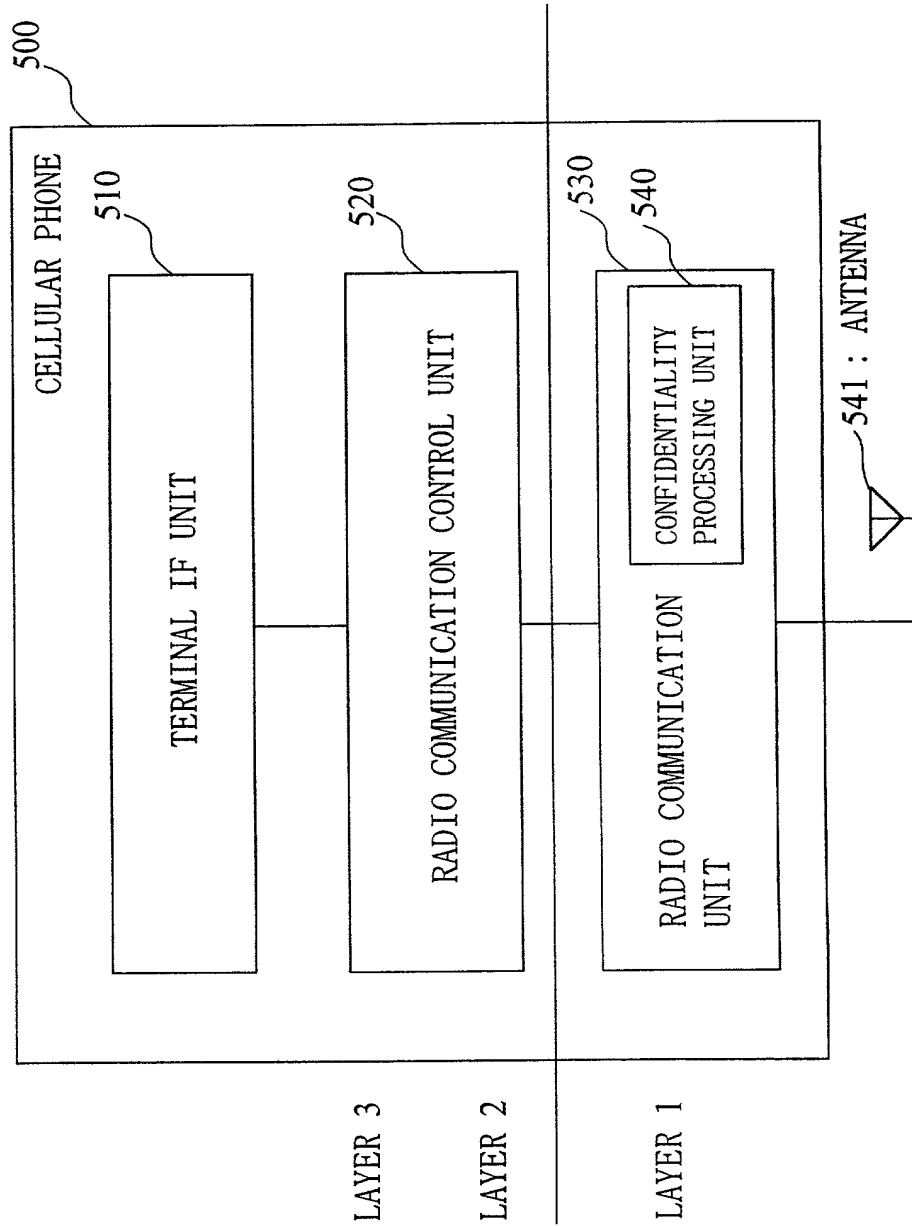
FIG. 22

23/24  
Fig. 23



24 /24

Fig. 24





# Declaration and Power of Attorney For Patent Application

## 特許出願宣告書及び委任状

### Japanese Language Declaration

#### 日本語宣告書

下記の氏名の発明者として、私は以下の通り宣言します。

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

上記発明の明細書は、

☐ 本書に添付されています。

☐ \_\_\_\_月\_\_日に提出され、米国出願番号または特許協定条約国際出願番号を\_\_\_\_とし、  
（該当する場合）\_\_\_\_に訂正されました。

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Radio Communication Apparatus  
and Radio Communication Method  
\_\_\_\_\_

the specification of which

☐ is attached hereto.

☒ was filed on December 22, 2000  
as United States Application Number or  
PCT International Application Number  
PCT/JP00/09128 and was amended on  
\_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

## Japanese Language Declaration (日本語宣告書)

私は、米国法典第 35 編 119 条(a)-(d)項又は 365 条(b)項に基づき下記の、米国以外の国の少なくとも一ヶ国を指定している特許協力条約 365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)  
外国での先行出願

<u>HEI 11-370657</u>	<u>Japan</u>
(Number) (番号)	(Country) (国名)
<u>                    </u>	<u>                    </u>
(Number) (番号)	(Country) (国名)

私は、第 35 編米国法典 119 条(e)項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

<u>                    </u>	<u>                    </u>
(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第 35 編 120 条に基づいて下記  
の米国特許出願に記載された権利、又は米国を指定し  
ている特許協力条約 365 条(c)に基づく権利をここに  
主張します。また、本出願の各請求範囲の内容が米国  
法典第 35 編 112 条第 1 項又は特許協力条約で規定さ  
れた方法で先行する米国特許出願に開示されていな  
い限り、その先行米国出願書提出日以降で本出願書の  
日本国内または特許協力条約国際提出日までの期間  
中に入手された、連邦規則法典第 37 編 1 条 56 項で  
定義された特許資格の有無に関する重要な情報につ  
いて開示義務があることを認識しています。

<u>                    </u>	<u>                    </u>
(Application No.) (出願番号)	(Filing Date) (出願日)
<u>                    </u>	<u>                    </u>
(Application No.) (出願番号)	(Filing Date) (出願日)

私は、私自身の知識に基づいて本宣告書中で私が行な  
う表明が真実であり、かつ私の入手した情報と私の信  
じるところに基づく表明が全て真実であると信じて  
いること、さらに故意になされた虚偽の表明及びそれ  
と同等の行為は米国法典第 18 編第 1001 条に基づ  
き、罰金または拘禁、もしくはその両方により処罰さ  
れること、そしてそのような故意による虚偽の声明を  
行なえば、出願した、又は既に許可された特許の有効  
性が失われることを認識し、よってここに上記のごと  
く宣誓を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or Inventor's certificate, or Section 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or Inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Claimed  
優先権主張

<u>27/December/1999</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(Day/Month/Year Field) (出願年月日)	Yes はい	No いいえ
<u>                    </u>	<input type="checkbox"/>	<input type="checkbox"/>
(Day/Month/Year Field) (出願年月日)	Yes はい	No いいえ

I hereby claim the benefit under Title 35, United States Code, Section 119 (e) of any United States provisional application(s) listed below.

(Status: Patented, Pending, Abandoned)  
(現況：特許許可済み、係属中、放棄済)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365 of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Status: Patented, Pending, Abandoned)  
(現況：特許許可済み、係属中、放棄済)

(Status: Patented, Pending, Abandoned)  
(現況：特許許可済み、係属中、放棄済)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

# Japanese Language Declaration

(日本語宣告書)

委任状: 私は下記の発明者として、本出願に関する一切の手続きを米国特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。  
(弁理士、または代理人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)



022850

書類送付先

Send Correspondence to



022850

直接電話連絡先: (名称及び電話番号)

Direct Telephone Calls to: (name and telephone number)

(703) 413-3000

単独発明者または第一の共同発明者の氏名	Full name of sole or first joint inventor	
	Shinsuke Uga	
発明者の署名	日付	Inventor's signature Date
		Shinsuke Uga July 28, 2001
住所	Residence	
	Tokyo, Japan	
国籍	Citizenship	
	Japan	
郵便の宛先	Post Office Address	
	c/o Mitsubishi Denki Kabushiki Kaisha 2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100-8310 Japan	
第二の共同発明者の氏名	Full name of second joint inventor, if any	
	Hiroshi Matsuyama	
第二の共同発明者の署名	日付	Second joint inventor's signature Date
		Hiroshi Matsuyama July 30, 2001
住所	Residence	
	Tokyo, Japan	
国籍	Citizenship	
	Japan	
郵便の宛先	Post Office Address	
	c/o Mitsubishi Denki Kabushiki Kaisha 2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100-8310 Japan	

(第三以降の共同発明者についても同様に記載し、署名すること)

(Supply similar information and signature for third and subsequent joint inventors.)

09925073-032701

# Japanese Language Declaration

(日本語宣言書)

第三共同発明者の氏名	Full name of third joint inventor, if any
第三共同発明者の署名	Third joint Inventor's signature
日付	Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

Takeshi Chikazawa  
 Takeshi Chikazawa July 31, 2001  
 Tokyo Japan  
 Japan  
 c/o Mitsubishi Denki Kabushiki Kaisha  
 2-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo  
 100-8310 Japan

第四共同発明者の氏名	Full name of fourth joint inventor, if any
第四共同発明者の署名	Fourth joint Inventor's signature
日付	Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

第五共同発明者の氏名	Full name of fifth joint inventor, if any
第五共同発明者の署名	Fifth joint Inventor's signature
日付	Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

第六共同発明者の氏名	Full name of sixth joint inventor, if any
第六共同発明者の署名	Sixth joint Inventor's signature
日付	Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

(第七またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。)

(Supply similar information and signature of seventh and subsequent joint inventors.)

05026078-032701